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EUROPEAN AGRICULTURE

AND

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RURAL ECONOMY.

FROM PERSONAL OBSERVATION.

BY

HENRY COLMAN.

> "For, in all things whatever, the mind is the most valuable and the most important; and in this scale the whole of agriculture is in a natural and just order; the beast is an informing principle to the plough and cart, the laborer is as reason to the beast, and the farmer is as a thinking and presiding principle to the laborer."—BURKE.

VOL. II.

BOSTON:
ARTHUR D. PHELPS, 116 WASHINGTON STREET.
LONDON:
JOHN PETHERAM, 94 HIGH HOLBORN.

1848.

Entered according to Act of Congress, in the year 1848, by
HENRY COLMAN,
In the Clerk's Office of the District Court of the District of Massachusetts.

NOTICE.

THE Ninth and Tenth Reports on European Agriculture and Rural Economy, complete the work, and are presented respectfully to my subscribers. The work has been delayed much beyond my own, as well as the expectations of others. This has been owing to two reasons: the difficulty of obtaining the information which I sought, and of presenting it in an acceptable and authentic form; and next, two or three severe illnesses, which for a while forbade all mental as well as physical effort. I am not willing to take any formal leave of my readers farther than to thank them for their indulgence.

The information, which the work contains, is as valuable now as it has been at any previous time. In regard to any agricultural operation, or crop, or improvement, the most full, explicit, and practical directions are given, and every peculiar feature brought prominently forward. Many things are omitted because they are of doubtful utility, or of uncertain authority. My great object has been, not to publish theories, but to state facts; and the determined results of enlightened, exact, and conclusive experiments. The work will be found to contain over a hundred pages more than were promised, which may be considered as an equivalent for matter which some may deem irrelevant to the subject; but which I have the gratification to think has attracted the attention of many persons to the work, who might otherwise have passed it by as too technical. In spite, however, of the intermixture of matter somewhat miscellaneous, though not wholly foreign to the subject, I may say that every thing of a practical nature is as fully detailed as the wants of my readers seemed to demand.

ERRATA.

Vol. I. Page 26, line 22, *for* Philipsburg-Square *read* Louisburg-Square.
" 30, " 11, *for* seldom *read* generally.
" 86, " 33, 1st ed. *for* John *read* Jesse.
" 101, " 16, " *for* water-lime *read* gray-lime.
" 105, " 18, " *for* those *read* some.
" 106, " 29, " *strike out the word* the.
" 121, " 33, " *for* conjectured *read* conjectural.
" 127, " 9, *for* three weeks *read* one week.
" 127, " 11, *strike out the whole line, and read*, The same amount of land in ploughing three times cost 7*s* per acre, each ploughing; total 21*s*.
" 156, " 19, 1st ed. *for* his business is now *read* finds his business now.
" 160, " 26, " *for* considerable *read* a good deal.
" 170, " 21, " *for* whom *read* who.
" 178, " 4, " *for* or *read* nor.
" 185, " 28, " *for* Hopetown *read* Hopetoun.
" 223, " 24, *for* to be done *read* to have been done.
" 255, " 4, *for* deportment *read* department.
" 270, " 4, *for* Deanster *read* Deanston.
" 279, " 8, *for* £1. 6*s*. *read* 2*s*. 6*d*.
" 290, " 25, *after beneath insert a comma.*
" 327, " 3, *for* these *read* such.
" 367, " 15, *strike out* or Scotch kale.
" 409, " 8, *for* time *read* lime.
" 463, " 19, *before* difference *insert* perceptible.
" 465, " 26, *after* thick *insert* as.

Vol. II. " 70, " 28, 30, 36, *for* Soompton *read* Scampton.
" 114, " 32, *for* effected *read* affected.
" 126, " 37, *for* Sworfield *read* Swarfield.
" 127, " 2, *for* Bransley *read* Bransby.
" 135, " 30, *for* constantly *read* commonly.
" 216, " 8, *for* Crogden *read* Croydon.

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PRELIMINARY OBSERVATIONS.

AGRICULTURE is the first and most important of all arts. Though not more honorable nor more innocent than many other arts and professions, yet it is perfectly innocent, and is as honorable as any. That likewise may be said of it, which can be said of few others, — it is essential to human subsistence. We shall find few persons in the community who do not at once assent to this; but often the assent is merely formal, and is not that deep and established conviction which should, much more than it does, prevail throughout the community; and especially amongst those who, gifted either by talents or station, have most concern in moulding human destinies, and in adjusting the interests, and forming the condition of society.

The affecting and extraordinary events of the last two years, should have their due influence upon every reflecting mind. In a single country, by the loss of a single crop, at least five hundred thousand persons have perished, amidst the accumulated horrors of starvation, or the diseases engendered and aggravated by famine. Ireland has its millions of fertile acres untilled, and its millions of strong hands unemployed. Had the agriculture of Ireland been what it should be, this terrible event — and one more terrible does not darken the pages of history — could not in all human probability have happened.

The essential character of the agricultural art is constantly pressing itself upon our attention. I have had from my childhood an inclination for rural pursuits. I have followed the plough many a day with a freedom and a buoyancy of spirit which seemed to have no counterpart but among the winged denizens of the air, who hovered around me, and with their thrilling notes cheered me on my way, and made the woods echo with their melody. I have cast the dry seed into the teeming earth, and watched its first bursting above the ground, and its gradual progress to maturity, recompensing every grateful attention bestowed upon it, until it poured its ripened treasures into my lap, with a grateful, and, I may add without presumption, a religious elevation of soul, which no language could adequately express.

We may be told, that agriculture is a purely material and sensual art, and does not deserve a place among the humane arts. To a mind material and sensual in all its habits, every thing becomes material and sensual in the lowest and most degrading sense of those terms. But its rational pursuit is not incompatible with high intellectual attainments, and the most refined taste. Whatever occupies and absorbs the mind exclusively, is, of course, unfavorable to any great excellence in other pursuits. Agriculture, pursued as a mere branch of trade or commerce, or a mere instrument of wealth, will be found to have influences upon the mind, narrowing and restricting its operations and aspirations, corresponding with any other of the pursuits of mere avarice and acquisition, and which even those of the learned professions, when pursued wholly with such views, are sure to have. But when followed without exclusive views to mere gain or profit, it is far from being incompatible with a high state of intellectual cultivation. Many of the sciences are the handmaids of agriculture, and serve, as well as ennoble it. Its practical pursuit, though it occupies, yet it does not exhaust the mind; but, within certain limits, inspirits and invigorates all its faculties. A spiritual mind may spiritualize all its operations; a religious mind sees, in its wonderful and curious processes and their marvellous results, many of the adorable miracles of a beneficent Providence. That a profound study of the agricultural art, and an intimate acquaintance and familiarity with its practical details, are not incompatible with a high degree of intellectual improvement and cultivation, we have too many living examples of this union to leave us to doubt; and the immortal names of Cicero, Bacon, and Washington, show, from their own assertions, that minds highly gifted of Heaven have found their richest pleasures in rural and agricultural occupations and pursuits; and in company with many others, in ancient and modern times, form a magnificent constellation of learning, genius, and taste, shedding their splendor upon this useful art.

When I hear this art spoken of with a sort of disdain, as wholly sensual and material, I would ask, What is there with which man has to do which is not material and sensual? All his organs of perception are material and sensual; all of that which he calls purely intellectual or spiritual, without the power of giving any intelligible definition of what he intends by it, is directly connected with, moved by, controlled by, and dependent upon his physical organization; and is vigorous as that is vigorous; healthy only as that is healthy; lives only by being well fed and well cared for. Even the pious clergy, who caution us so strongly against secular pursuits, and against seeking things earthly and temporal, without the labors of the husbandman, without beef and bread, without wool and silk, without milk and honey, since manna has ceased to come down from heaven by night, and the rock no longer pours forth its crystal treasures at the touch of the prophet's wand, could give us neither their prayers nor their exhortations; the pious hands could not be raised to Heaven for its benediction, and the eloquent lips would become dumb.

I believe the agricultural profession is highly favorable to good morals; I shall not presume to say more so than any other; but it will not be too much to say more so than many others. Perhaps it will be said, that the agricultural districts of England and other countries yield their full proportion of crime. I will not peremptorily deny what is often confidently asserted; but I am not ready to concede to it until other proof than I have yet received is furnished. As far as my own personal observation and experience go, my conviction is the reverse of this. Two fruitful sources of crime are to be found in excited passions and in powerful temptations. Agricultural occupations, so far from exciting, tend to exhaust and allay the passions; and the retirement and seclusion of the country present fewer temptations than the tumultuous life, the opportunities for vicious association, the disorderly hours, and the infinite variety of attractions and engagements of city life. Among, however, a degraded population, poor and half-fed, without education, without any interest in the soil, without friends to take an interest in their welfare, without any sentiment of the value of character, without self-respect, accustomed to pass their unoccupied time in drinking-houses and in degrading pleasures, and treated and lodged without distinction of sex, and without any regard to the common decencies of life, it is not surprising to find a nursery and hot-bed of crime, where it shoots up in startling luxuriance. My acquaintance with many of the villages and rural districts of England and Scotland satisfy me that the favorable moral influences which might be looked for from rural life and agricultural pursuits, are there found in full operation; and under a system of more general and improved education, and especially under institutions which would give those encouragements to labor which are the most powerful motives, as well as the proper rewards of industry and good conduct, these influences might be expected to be even more general.

Let me speak of a district or country with which I have been many years familiar*: it is a purely agricultural district; it contains nearly half a million of inhabitants; its climate is cold and severe; its soil, with some exceptions, of moderate fertility, and requiring the brave and strong hand of toil to make it productive. It has public and free schools in every town and parish, and several seminaries of learning of a higher character, and where the branches of a useful and literary education are taught, at an expense so moderate, that it is placed within the reach of persons even of the most humble means. It has every where places of religious worship, of such a variety that every man may follow the dictates of his own conscience, where religious services are always maintained with intelligence and decorum, sustained wholly by voluntary contributions; and sects of the most discordant opinions live in perfect harmony, recognising in their mutual dependence the strongest grounds for mutual forbearance and kindness. Taken as a community, they are the best-informed people I have known; and they have numerous and well-chosen circulating libraries in almost every town. They have no connexion with any large market; and the produce which they have for sale, goes through intermediate hands to the great marts. They have few or no poor, and those only the emigrants who may stroll there from neighboring provinces. The sobriety of the people is remarkable ; they are every where a well-dressed people ; their houses abound in all the substantial comforts and luxuries of life ; and their hospitality is unbounded. They understand their rights and their duties, and have often distinguished themselves by an extraordinary bravery and manliness in their vindication and defence. No where is public order more maintained, or public peace better preserved ; large portions of the inhabitants never bolt a door, nor fasten a window, at night ; and in a village of some thousand inhabitants, I have known a garden stored with delicious fruit, with no other fence than one which served as a protection against cattle, as entirely secure from intrusion or plunder, as if it had been surrounded even with a prison-wall bristled with *chevaux-de-frise*. In this State crimes are comparatively rare ; courts of penal justice have little occupation ; the prisons are often without a tenant, and there has been scarcely a public execution for half a century. From such an example of a community almost exclusively agricultural, I have a right to claim for agricultural and rural life, all the beneficial moral and social influences to which its enthusiastic admirers pretend.

---

* The State of Vermont, United States.

The present excited state of the civilized world ought more than ever to call the attention of philanthropic individuals and of governments to the immense importance of agriculture. I have been in France during the exciting scenes of a political revolution, in which I have seen very many thousands of workmen without the means of support from their labor, and large bodies of them actually dependent upon public charity for their daily bread. It is not the dangers to public liberty and order, growing out of such large unemployed and destitute multitudes, which so much disturb me, as the actual suffering to which they are exposed, and the melancholy future that lies before them. In London I have encountered, with an extreme depression of heart, thousands of squalid, ragged, miserable poor, without resource but from crime or charity. A distinguished manufacturer in one of the most industrious counties in England, states that there are at least five hundred thousand operatives without employment, and many on the borders of starvation : tradesmen and professional men will tell you that every trade and profession is overstocked ; and one is daily saluted with the melancholy, not to say presumptuous exclamation, that there are too many people. This reminds one of the sad shipwreck of the French frigate, the Alceste, when many of the wretched survivors, who were floating upon a raft composed of fragments of the ship, deemed it necessary to their own safety, to drive by force a large portion of their suffering companions into the sea — a sad and horrible alternative.

It would be more than absurd in me to attempt to prescribe a remedy for evils upon which so many sagacious heads and philanthropic hearts have concentrated without success their powerful energies. But I will point out what I deem the true cause of this great evil, and leave to wiser minds to suggest a cure. One thing is certain ; as matters go on, the evil must extend itself, and become every day more aggravated and terrible, unless some remedy is devised. The remedies for the wretched, or, if not wretched, the unfortunate condition of the laboring classes, which have been proposed in Paris by men whose good intentions I would not distrust, and which have been so fully and publicly discussed, are absurd, impracticable, and mischievous. The interference of government in limiting or fixing the hours of adult labor; in attempting to establish a rate of wages irrespective of the time employed; in proposing to equalize the wages of all trades, and determining the same rate for the skilled and the unskilled, the active and the indolent; the proposition to furnish the unemployed with work at the national expense, and to destroy private competition by the establishment of national workshops, are all of them attempts which are sure to defeat themselves, and which are as impracticable for the end which they propose, as to attempt to chain the wind, or to stop the flowing of the tide. — None of them touch the true cause of the evil.

Must we affirm, then, that there are too many people in the world; and that thousands and millions are born into it for whom there is no place at the table of a beneficent Providence? Why, in France there are more than nineteen millions of untilled and unoccupied acres, and in England more than eight millions, all capable of yielding food and clothing to countless human beings; and here and in other lands there are millions of acres, for the want of labor which might be applied, that produce not a moiety of what they might be made to produce. In ancient Rome, seven acres were the ordinary size of farms on which a family might be sustained. In Flanders, on a soil which was once sterile, but which human labor has made productive, two and a half acres will give ample support for a man and wife and three children, or what is considered equal to three grown-up men and a half; and add to it three acres more, which this amount of labor is more than sufficient to cultivate, and you add a considerable surplus for other purposes.

The great cause, then, of the evils complained of, is, that the cultivation of the earth is deserted; and that such innumerable multitudes pour into cities and towns, and, filling every profession and every mechanical art and trade, destroy each other by a competition in articles of which the demand is necessarily limited. There may be too many physicians, too many lawyers, and too many ministers, for them all to get a sufficient and an honest living; and too many hatters, and too many printers, and too many shop-keepers; for, besides that these persons furnish more of a particular article or service than the community require, their work is in general only formal; they *only* manufacture, they do not produce; they do not, like the grower of bread and of clothing, create that which may be said to have a substantial and permanent value. For when was the time when there was too great an abundance of the materials — I mean particularly of those which can be kept from year to year — for food and clothing, for human subsistence and comfort. As long as this state of things continues, there must be misery in the community; as the population increases, this misery must increase.

In cities, money becomes the standard of prosperity. Wages are paid in money; money is the instrument of subsistence, of gain, and of pleasure. Avarice, under these circumstances, becomes stimulated to excess, and often leads to crime. Men's happiness becomes dependent upon that which has no intrinsic, but only an arbitrary value, — a value which is always capricious, and continually changing. If men could be induced to cultivate the earth, and, trained to the simple habits of laborious and rural life, be satisfied with what that affords them; if they would measure their prosperity and wealth, not by so many shining pieces of gold or silver, which they have hoarded in their closets, but by the produce of their labor in bread and clothing, and the various and innumerable simple luxuries of life, with which a kind Providence so often blesses the labors even of the most humble, how changed would be their condition! If they could be as well satisfied to breathe the fresh air of their native mountains and forests as the corrupt and pestilential atmosphere of crowded streets and confined dwellings, from which both sun and light are shut out; as well content to enjoy the simple and healthful sports of the country, as the exciting and exhausting pleasures of city life; if their taste could be better satisfied to contemplate the verdant fields, waving with crops or enamelled with flowers, than carpeted and gilded halls; if they could be taught to prefer skies painted with clouds of brilliant hues, and studded with stars whose lustre never grows dim, to palaces blazing with artificial lustres and adorned with the far inferior magnificence of man's genius and taste; if, indeed, by any possible means, you could induce men and women, and, above all, the young, to love the country; if, in a word, you could keep them in the country by an attachment to its simple labors and recreations, and prevent their crowding cities to repletion, and thus destroying by competition the ordinary professions and trades which prevail there, where so many vigorous young men, and so many fair and blooming maidens rush in, like flies in a summer evening into a blazing taper, to find too often the grave of their health, hopes, happiness, and virtue, what an immense gain would be achieved for morals and for humanity!

But while matters continue otherwise, while such millions of acres remain unoccupied, while such thousands upon thousands crowd into the learned professions, and into the mechanical arts and trades, and fill cities to repletion, under the powerful stimulus of a vain ambition, an inordinate avarice, or a love of excitement, luxury, and pleasure as inordinate and unrestrained, we shall continue to complain of a superabundance of population; and that superabundance, wherever the wave accumulates, will bring with it crime and misery. The decrees of Divine Providence cannot be violated with impunity. Every inordinate and unrestrained passion will yield its bitter fruits. Every infraction of the laws of man's moral constitution will be followed with its just and inevitable penalty.

To my mind, then, the great causes of the evils of which society, especially in the old countries of Europe, is every where complaining, are primarily those which are now pointed out, — an excessive crowding of the professions, trades, and mechanic arts, creating a most baneful competition, and an entirely false assumption, which every where fixes itself in men's minds, that pecuniary wealth is the true standard of prosperity. Competition, which, when excessive, is so hurtful and serious in the mechanic arts and trades, is, in agriculture, always a good. Under proper management the earth cannot be made to produce too much. It is a generally received theory, that as yet there has been no surplus produce; that what is grown in one year is, upon an average, only sufficient for that year; and that one year's entire failure of the crops would cause the destruction of the human race. I shall not speculate upon this theory, which, possibly, may be well founded, but which Heaven forbid that it should be put soon to experiment. In some years there may be a surplus of some products, and then there may be a dearth of others. But I have never known too much grown: I have never known the great mass of mankind enjoying too much bread, or too much clothing, or too many of the substantial comforts of life. If they get the comforts, or their substantial necessities are supplied, then certainly we should desire that they should have the luxuries of life in addition, — above all, those simple luxuries which are the produce of their own honest labor, and to which that circumstance alone will always give a peculiar zest.

Can any thing be done to remedy or abate this great evil, and to turn aside this rushing current, which threatens to accumulate in such masses of frightful misery? This is a great inquiry for the philanthropist, and for all governments which have at heart the only proper object of government, that is, the welfare of the governed. The Divine Providence often punishes human cupidity and madness by its judgments; but war, disease, famine, and floods, which sweep away their tens and hundreds of thousands, are dreadful curatives. They seem only temporary in their operation. They lay waste instead of fertilizing. They make man's heart sink within him; and they leave behind them nothing consolatory or hopeful. No reflecting mind, at least no mind with any experience of human life, will suppose for a moment that any effectual remedy can be at once discovered or applied. It is only the madness, or enthusiasm, if the milder term is more fitting, of a French revolutionist, which dreams that the whole form and relations of society can be suddenly changed, and that the next morning's sun shall rise upon a cloudless sky, bringing back the golden age, dispelling all the fogs and mists of night, drying up all the sources of human misery, and pouring out a flood of universal peace, plenty, and happiness.

While human weakness and passions remain what they are, no complete remedy is ever to be even hoped for. It does not yet appear that Heaven designed that man should realize an optimism in this world. To our humble views it seems to be the aim of Divine Providence, by the limitations, uncertainties, imperfections, and trials of this state, to stimulate a virtuous ambition, and to arouse the minds of the well-disposed to all possible exertion to ameliorate the condition of their fellow-men. There is one great encouragement to every philanthropic attempt. Little as any individual, or any combination of individuals, can effect, yet I believe truly that no benevolent exertion, however humble, ever failed to produce some good; and experience constantly shows that seed, which has been cast into the ground, may lie long concealed, may not show itself above the surface even during the life-time of those who planted it, to gladden their eyes, yet it may yield, though a late, an ample harvest.

Every one knows the power of public opinion, and how all the world are influenced by fashion, or what is called general sentiment. I have heard of a man who was asked, as is common on leaving church, "How he liked the preacher?" His honest reply was, that "he did not know; he had not heard any body say." This homely anecdote illustrates a striking element in the human character; and shows how much our judgments, and consequently our actions to a certain extent, depend upon the rank which most things hold in public estimation.

I wish to see an agricultural life, much more than it is, the choice of men of fortune, of influence, of talents, occupying the higher positions in society; and this, not as mere *dilettanti* or amateurs, but as plain, active, practical husbandmen; men, not merely to come on deck in some fine sun-shiny day, to admire the ship with all her canvass filled, and all her streamers flying, as a beautiful object of art, and, in a spasm of poetical frenzy, to enjoy the deep green of the ocean, and its graceful undulations, and its ruffled waves; but who understand perfectly the art of navigation, who "know every rope in the ship," the nature and stowage of the cargo, and the place and duties of every man in the company.

I have devoted weeks, and months, and years, in my humble way, to recommend this noble art, to vindicate its claims to the attention of those who have at heart their own and the welfare of the community, to show that it is a source, if not of large, yet of reasonable profits; that as an occupation it is as honorable as it is useful; that it conduces to health of body and peace of mind; that rural pleasures are, to a well-disciplined mind, among the last to cloy and exhaust it, and wholly pure and innocent; but especially, that a strictly agricultural life, under those reasonable limitations which apply to every other pursuit, is not incompatible with the pursuit of science and the cultivation of a refined taste; so that men of fortune, talents, and liberal education, who now sacrifice their fortunes in the idle pastimes and frivolities of city life, and their health and peace of mind in its feverish excitements, and the competitions of a diseased vanity and ambition, would find in the simple and hospitable habits of rural life, health and vigor of body and mind, and that independence of money and of time, and opportunities for general reading, or the prosecution of any favorite science, which it is almost impossible to find in the crowded haunts and the eternal and ever-varying round of city engagements and pleasures. The most gifted minds accomplish comparatively little, and fall far short of what might be hoped and expected. The most humble contributions may not be without avail in affecting the mass of public opinion and sentiment. I am happy in thinking that I have sometimes struck a sympathetic chord in some generous minds; and under any and every discouragement, I console myself with the perfect and serene consciousness of having labored at a purpose wholly disinterested, innocent, and useful.

What governments should do in the case, is a most important question. A great portion of the governments which have existed, have been little else than an unmitigated curse to mankind. The accumulation of wealth, the acquisition of territory, family aggrandizement, purposes of purely selfish ambition, the mere pomp and luxuries of life, military domination and despotism, have been almost the sole purposes aimed at by the governments of the world. The only legitimate purposes of government are the security and welfare of the governed; but how little have these been regarded! how often entirely overlooked! Holding, as I do, all offensive war, of every description, and under any pretext, as a crime against humanity and against God, one's heart bleeds at the recitals of history, which seem little else than recitals of bloody conquests and human slaughter, of wasted fields, of famishing millions, and of sacked and burning villages. If the millions and millions of laboring hands, of sacrificed lives, and of hardly-earned treasures, which have been worse than squandered upon these wicked objects, had been devoted to the subjugation and cultivation of the waste places of the earth, and, instead of attempts to destroy, society had devoted itself to attempts to save life, and to the production of food and the multiplication of the comforts and innocent luxuries of mankind, how different would have been the result!

What an extraordinary moral anomaly, if so it may be called, does France at this moment present; a nation on the verge of bankruptcy, burdened with excessive taxation, with an army of four hundred thousand men, and more than nineteen millions of acres of unoccupied land, all susceptible of cultivation, and of feeding and clothing millions! Does Great Britain furnish no parallel to this monstrous fact? With an increasing national debt, whose payment is perfectly hopeless, a weight of taxation the subject of universal complaint, millions upon millions lavished upon her armies and navies; workhouses and prisons filled to repletion; thousands and hundreds of thousands upon the verge of starvation; and in the two great islands, resplendent with the brightest lights of civilization, more than thirteen millions of acres of unoccupied land, and even her cultivated soil, with an improved agriculture, capable of sustaining in plenty three times the number of those who now draw nourishment from her breast. What a singular conjuncture of circumstances!

Are not these monstrous facts; deeply distressing to philanthropy; deeply wounding to human pride? We may well ask — If in two of the most enlightened, the most civilized, and the most polished nations which have ever existed, nothing better has been attained, or rather so much remains unaccomplished for human comfort, such a mass of human crime and misery remains unreached and unalleviated; have we not some reason to ask, what are the blessings, and what are the triumphs of civilization? We have a right to demand whether the true ends of government and society have been answered; whether it has really reached the limits of its power for good; and whether it has not yet to study the arts of peace and the public welfare. The expenses of fortifying Paris and of providing its armaments, would have converted a whole department into a garden, teeming with the substantive comforts and luxuries of life. The enormous expenses of the wars, under the empire, of which now little remains but triumphal arches stained all over with human blood, and splendid monuments to the glory of one of the great butchers of the human species, would have converted the whole of France into a fruitful field; planted every where schools, churches, colleges, and smiling villages; filled her every where with the industrial arts, and with monuments of taste; banished, under the blessing of Heaven, all want, where there was industry to collect, and frugality to use the products of nature's bounty; and put it in the power of every one of her thirty-six millions of people to sit down in peace and comfort under his own vine and fig-tree. The moneys expended in the naval armaments of Great Britain, in the preparations of munitions of war, in the support of her navies and armies in any year of her history, what would not they have done in subduing and making her waste lands productive! The sums expended for her defence of Ireland, for the repression of disorders, in a great measure consequent upon her wants and miseries, and the vast sums bestowed upon that wretched country in charity, the necessity of which springs directly and wholly from its neglected and wretched agriculture, what would not they have accomplished in draining her bogs, in enriching her meadows, in changing her mud hovels into comfortable cottages; in warding off the grim horrors of famine, and in raising millions of human beings, sunk, as I myself have witnessed, in a lower degradation than that in which it seemed possible that human life could be sustained, to the common level of humanity, and even to a high measure of comfort and civilization!

What then shall government do to remedy the dreadful evils under which civilized society is now groaning aloud; and one part of God's family is impiously complaining that He permits another portion, though with equal rights as themselves, to come into the world; and our cities, from an excessive competition or production in the pursuits of mechanical industry, or in the learned professions, are every where teeming with masses of misery and crime? I do not say that an extended and improved agriculture would prove the only remedy; nor that it would prove a certain remedy; but I believe it would prove effectual to a certain and large degree; and I demand to know what single remedy will prove more efficient. To whatever degree, be it more or less, to which it is extended, it increases national wealth; it multiplies the means of subsistence; it withdraws men from the competitions of trade and manufactures; and, above all, it attaches men to the soil, and so far gives a pledge of order, loyalty, and patriotism.

The efforts of government, then, should be directed to give every possible facility and protection to this art or pursuit; to render land accessible; to break up those tenures under which, by various provisions, worthy only of a barbarous age, land is kept out of cultivation; to alleviate, as much as possible, the burdens upon land; to assist in all those great improvements, which are too vast for individual effort; to diffuse agricultural knowledge; to promote agricultural education; to learn and translate the improvements and crops of other countries; and by honors and premiums to encourage an emulation in the only art in which emulation is not only innocent and harmless, but always useful to all parties; and thus to stimulate cultivation and improvement in every branch of this art, and habits of domestic economy, by every practicable means. What governments can do on a large scale, landlords and proprietors may do perhaps more efficiently and successfully within their own domains. May they feel the great responsibility which their situation imposes on them! If any one of the great nations of Europe would give but half the attention and half the expense to the improvement of its agriculture, which it now bestows upon its military preparations and improvements, we might expect an equal proficiency in the one art as in the other. Which should be preferred; whether it be better to save life or to destroy, I leave to the judgment of my readers.

It is now only a few months since I passed a day at Waterloo. I saw, waving with their luxuriant crops, the fields which had been enriched by torrents of human blood: I stood upon the grassy mound under which tens of slaughtered thousands lay entombed. I have a profound reverence for that heroism which bares its bosom in defence of right, justice, and freedom; but I have no respect for that tiger-ferocity which delights in human carnage, and that mad enthusiasm which follows, reckless of its own and of other lives, the phantom which men call military glory. The cannon's roar, the waving plumes, the burnished helmet, the bristling bayonets glittering in the sunshine, have no charms for me. I took in my hands a skull pierced by a ball, which the plough had recently turned up. I thought for a moment of the burning passions, the fiery hate, the thirst for revenge, for conquest, and for blood, which had filled and swelled in this little casket, — the noblest production of Divine power, — when death instantly demanded the account. Other associations rushed upon the mind. I thought of some once cheerful fireside made desolate; of some aged mother robbed of her staff; of a widow cast friendless upon the world; of orphan children, and of weeping friends. And this, said I to myself, is military glory; these are the trophies of war. I found the springs of feeling beginning to be deeply moved. I turned my eyes at once to other neighboring fields of conquest which I had recently left. I had seen millions of acres, by an enterprise truly grand, a courage most heroic, a labor most indomitable, rescued from the sea, and its proud waves repelled; barren sands converted into fruitful fields; and where the ocean held its profitless sway, and the winds and waves and tempests were accustomed to spend their mingled and destructive violence, the calmness and security of rural life every where triumphant; fields crowned with plenty, and speckled every where with rejoicing herds; and cities and villages swarming with busy and happy thousands, and rich in all the arts and luxuries of civilized and refined life. I did not need to ask myself, what conquests are the most noble?

I hope my kind reader will not deem these reflections misplaced, as preliminary to the somewhat dry task and the plain matters of fact to which I now invite him. One of the most distinguished agriculturists which England ever produced, said "that the best way of improving agriculture was to go abroad and see what other people were doing." I have been now some time in Great Britain and on the Continent, that I might see what other people were doing, and learn from personal observation the true state of the agriculture and the rural economy of the old world; that I might present to the agricultural community in my own country, and in other places, matters of instruction and examples for imitation, if such were to be found; or subjects of congratulation if their own improvements have already placed them in advance, and left them nothing to learn. A full survey of European agriculture is a task for many minds, for many years of observation, and for higher talents and acquirements than I could bring to the work. Yet I shall deem it no mean honor to contribute any useful service to so important an object. It will be understood that I enter the field only as a gleaner. It is said that the gleaners often bring home the heaviest and the ripest heads of grain, because these are the first to drop from the stalks. I shall be but too happy if the analogy should be found to hold in my case.

I shall commence the ninth part with sketches of French agriculture, and these will be followed by, and sometimes intermingled with, sketches of Flemish and Swiss agriculture, and other observations which may have suggested themselves in the course of my tour. There may be found some deficiencies, because I mean to state nothing, unless otherwise declared, which has not been verified by personal observation; but, on the other hand, there will be this advantage, that such statements rest upon a responsible authority. My great object will be to give almost exclusively information of a practical character; but if occasionally there may appear some slight digressions, my kind reader will regard them only as watering-places on the journey, where the traveller loosens the reins and dismounts for a moment in a dry and dusty road, that he may renew his progress with more freshness and vigor.

EUROPEAN AGRICULTURE.

SIXTH REPORT.

I PROCEED, in this Report, to treat of other processes than those which I have described in the management of arable land.

XC. — PARING AND BURNING.

The process of paring and burning the surface of the land has been practised with great, though not always with equal, success in many parts of the country. The objects of it are threefold: the first, to reduce the coarse vegetable matter on the surface to a state of decomposition, that it may be supplanted by a more profitable vegetation; the second, to destroy grubs, insects, and the larvæ of insects, which infest the soils, and are pernicious to the cultivated crops; and the third, to convert the coarse, vegetable matter on the surface into ashes, for the nutriment of the crops which are to follow. This process is not to be confounded with that, which I shall afterwards describe, of burning clay for the purpose of manure and of rendering the soil friable and pervious to the roots of plants.

In the operation of paring and burning, a thin slice, or turf, varying from one to three inches, is taken from the surface, and, after being sufficiently dried, is cut into pieces of a convenient length, and then piled in heaps preparatory to being burned and reduced to ashes. The turf is cut sometimes with a plough with a broad share, of the width of the slice desired to be raised, or, otherwise, with a spade made thin, with a flange or wing on one side of the blade, resembling, in this respect, a spade for the cutting of peat, and with a long and curved handle, with a cross-piece at the end, by which it is forced under the sward by a pressure against the thighs of the workman. The work, when performed with the spade, is deemed severe, and it is considered a sufficient day's work for a man to accomplish a quarter of an acre.

The sods, when collected, are piled in heaps of a larger or smaller size, according to the convenience of the operator, pains being taken to form a sort of furnace beneath, in which are placed some brushwood, fagots, or coal, as in the oven of a brickkiln. The sods are piled over this; and, fire being kindled, attention is paid to prevent its blazing out, so that wherever a hole is found, by which the fire might escape, it is immediately filled up with fresh dirt; and, as the fire advances, new sods are occasionally heaped upon the pile; the object being to reduce the whole to ashes by a smouldering fire. It is surprising to find to what a fine state the sods and vegetable matter may be reduced, and how the burning will continue to go on, though the whole seems to be in a state of perfect quiescence. A thorough burning requires frequently a month, or a longer time, for its completion.

The headlands of a field are occasionally burned without the rest of the field being subjected to the same process. Here there is always an accumulation of soil, and a collection of rubbish, coarse grass, weeds, or bushes; and all these are dug up occasionally to the depth of six or ten inches, and piled in heaps, and burned as I have above described. In cases where the whole is not consumed, the part which is not sufficiently reduced by the action of the fire is transferred to another heap. Two or three pieces of advice are commonly given in regard to the management of this burning. One is, not to make the heaps too large in the beginning, as the weight of the incumbent mass is liable to extinguish the fire, but to heap it up gradually as the fire goes on; the second is, not to allow the fire to blaze out, as else it would soon burn itself out; and a third is, not to make the fire too hot, as otherwise much of the earth, instead of being made to crumble, and reduced to a friable state, would become baked hard, like bricks.

The ashes, then, of these heaps are evenly spread over the fields operated upon; and this is generally followed by a green crop, such as vetches or turnips, which, under good management, are consumed on the field. Then follows the usual course of wheat, barley, and grass. The amount of ashes, obtained by the ordinary process of paring and burning, has been made the subject of exact calculation, and is so remarkable that I deem it worth stating. "An acre of land, from which the turf was taken in the common mode of paring and burning, appeared to have produced an average of 2660 bushels of ashes, which, at their mean weight of 65 pounds to a bushel, when dry, would give 172,900 pounds, or rather more than 77 tons, per acre."

The subject of paring and burning land has been long matter of warm discussion. Of its advantages, in many cases, there can be no doubt. In the well-cultivated county of Essex, it is a constant and successful practice. A distinguished farmer states that he has practised it for more than twenty years; and where, when he began the practice, he was able to keep only one, he now keeps six sheep. It has been said that the destruction of the vegetable matter in the soil must necessarily impoverish it; and that it would be much better to bury this vegetable matter, where, by a slow decomposition, it might serve to afford nutriment to the crops to be cultivated. There are, in the first place, some mechanical difficulties in the case. Where a piece of heath land, covered with coarse grasses and low bushes of furze or fern, is ploughed, it is extremely difficult, even by the most severe process of pressing or rolling, to make it lie flat, and so consolidate it that it can be cultivated to advantage. This is stated to have been the fact, on an extensive heath in Surrey, where cultivation, under the practice of paring and burning, succeeded well, but very ill where the land was only turned over without paring and burning. "In the former case, the land was immediately fit for turnips, tares, barley, and clover; in the latter, the tough wiry-bent heath, and dwarf furze, kept the land too light and spongy for any crop. Even rolling could not keep it down, for its elasticity raised the soil soon after the roller had passed over it, and it is of so imperishable a nature, that it is likely to plague the farmer for many years." There are certainly strong reasons, in such cases, for paring and burning fields of this description; but they do not apply to those lands where the vegetable matter is of a different description, and would, by being covered over, be speedily brought into a state of decomposition. Here the expediency of paring and burning is more questionable.

In the process of burning, it is evident that none of the earthy or mineral constituents, or what are called the *inorganic* portions of the soil, are consumed. But all the vegetable matter, with the exception of that portion which has become charred in the process, is destroyed. The extreme doctrine of some eminent chemists is, that the humus, or vegetable portion of the soil, is of no importance to vegetation; but universal experience and observation seem to attest that the fertility of soils, with some exceptions, may be ordinarily determined by the quantity of decayed vegetable matter or mould in which they abound. If plants, in fact, derive nothing from the soil but the mineral ingredients which are found in them, yet the humus of the soil may itself be the means of abstracting from the air, and conducting to the plants, the nourishment, the carbonic acid, and the ammonia, which they are to obtain from thence.* The humus of the soil serves to render it more friable; it absorbs moisture from the atmosphere, and it retains heat, and, in these respects, if in no other, contributes to vegetation.† In dissipating this matter, then, by burning, we must look for some compensation in the ashes which are produced, or in the mechanical effects which this burning operates upon the soil. The ashes themselves are powerful absorbents and retainers of moisture, and they answer a valuable purpose in the disintegration, or loosening, of the soil. They certainly, in many cases, operate as an efficient manure. I have seen their effects often, both upon old and new land. In examining the returns of nearly four thousand different wheat crops in Massachusetts, in which, with a view to secure the premium offered by the state upon the cultivation of wheat, it was required to give the mode of culture in detail, I found, in every case where ashes were applied to manure the crop, the beneficial effects were emphatically affirmed. In clearing new land, it has been the custom to fell the standing wood, and, after it has become sufficiently dried, to burn it completely upon the land. This always leaves a large deposit of ashes on the ground. It is common to plant Indian corn directly upon these ashes, without ploughing the land, and, at the close of the season, at the last hoeing of the corn, or indeed its only hoeing, to sow wheat among it, which, to use the common phrase, is then "hacked in" by the hoe. Some of the largest crops of Indian corn and of wheat, which I have ever known, have been grown in this way. In one case, upon a very large field, the product of wheat averaged sixty-four bushels to the acre. What is the chemical effect of ashes, I believe, is not well ascertained; but I shall presently let those give their opinion who assume to understand their operation. It seems natural to infer, that that which once formed a constituent element in a plant may serve as food for another plant of the same species. There may be other uses, which are not so direct and obvious, but equally efficient.

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* "Humus, in contact with air, gives off carbonic acid." . . . . . "The capital fact which results from these experiments of Saussure, the deduction directly applicable to the theory of manures, is this — that humus is dissipated when it is exposed to the air; and that, during the slow combustion which it undergoes, it is a constant source of carbonic acid gas." — *Boussingault*, p. 323.

"Potash and soda dissolve humus almost completely, causing an evolution of ammonia." — *Ibid.* p. 321.

† "There is an important element, which must always be taken into the account in estimating the value of soils, no matter what their special composition; this element is their depth, or thickness. In running a deepish furrow in a cultivated field, we generally distinguish at a glance the depth of the superficial layer, which is commonly designated as the mould, or vegetable earth; this is a layer generally impregnated with humus, and looser and more friable than the subsoil upon which it rests. The thickness of this superficial layer is extremely variable. It is frequently no more than about three inches; but it is also encountered of every depth, from three or four to twelve or thirteen inches. It must be held an exceptional and unusual case, when it has a depth of three feet, or more. Nevertheless, we do meet with collections of vegetable soil of great depth, deposited by rivers, washed down into the bottoms of valleys, or accumulated on the surface, as in the virgin forests or vast prairies of America. Depth of mould or vegetable soil is always advantageous; it is one of the best conditions to successful agriculture. If we have depth of soil, and the roots of our plants do not penetrate

The expediency of paring and burning land must, as I have remarked, depend upon the nature of the soil which is to be

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sufficiently to derive benefit from the fertility that lies below, we can always, by working a little deeper, bring up the inferior layers to the surface, and so make them concur in fertilizing the soil. Independently of this great advantage, a deep soil suffers less either from excess or deficiency of moisture; the rain that falls has more to moisten, and is therefore absorbed in greater quantity than by thin soils; and, once imbibed, it remains in store against drought." — *Boussingault*, p. 297.

subjected to the process. On light, sandy, or gravelly soils, where the vegetation is thin and sparse, it is strongly objectionable. I will subjoin here an extract of a letter, with which I have been favored, from the intelligent steward of the excellently-managed farm of Lord Hatherton, at Teddesley, Staffordshire. "With respect to the trial we made, of paring and burning some of the high heath lands at Teddesley, we prepared two small patches, about half an acre each, in the usual way, in the spring of 1844, upon the highest part of the Teddesley common, and the ashes were spread and harrowed when the turnip seed was sown. The other part was ploughed and dressed with about five tons of lime to the acre, and sown with turnips at the same time as the above; but, in consequence of the summer of 1844 being unusually dry, both experiments were deficient. We again sowed the land with turnips last June, and the land prepared with lime has now a decided advantage, and I have not the least doubt it will be much more apparent in the next crop, which will be oats. I have frequently witnessed the experiment of paring and burning waste lands, when they are first brought into cultivation; but in no instance should I recommend its adoption upon dry, sandy soils, which are already deficient in vegetable matter, which is the case with most of the common lands in this neighborhood, particularly the high lands. The crop of oats was grown upon the highest part of the common, after a crop of turnips, for which the land was broken up and limed, as I have before stated." "The crop of oats on this land, of which there were sixty acres, were at the rate of full sixty bushels to the acre — the result of heavily liming the land when first broken up, and then twice eating turnips off it;" (that is, eating them on it, by folding the sheep upon it. — H. C.) "On no other plan than that of taking nothing out of the land, and putting as much as possible in, could such a produce of oats have been obtained from such a soil." *

The lime, in this case, if it were copiously applied, as I saw

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* Since writing the above, a very competent friend writes to me thus: "The experiment of burning did not answer. All my experience has satisfied me that it will not do on my ground. Nor do I believe that it is a good thing any where, where other means of reducing vegetable matter can be had. I have pared and burned a good deal formerly. It brought good crops, but the land was clearly impoverished afterwards."

preparations for doing on another part of the farm, may have assisted, as the fire would have done, in the decomposition of the vegetable matter. The lime is advised to be applied always with the ashes, when the surface is pared and burned. They are stated to work well together. A certain gentleman, about to undertake the office of a judge, was advised, by another very shrewd and experienced magistrate, to give his decisions without giving the reasons for those decisions. Perhaps he saw that his causality was deficient, or knew how often it happens in life that for many exceedingly well-established facts it is very difficult to give any reasons. I avail myself, in this case, of the same sage advice. The effects of lime are in a degree capricious and uncertain. I know that they must follow the general and established laws of nature; but, in spite of the confidence of some men, it does not appear that these laws are yet fully understood. A deficiency of lime in the soil implies the necessity and advantages of its application; but the "quantitive philosophy," as it is called, leaves me sometimes at a loss, when I am told, on the one hand, that the ashes of a crop of clover, on an acre, contain full three bushels of gypsum; and know, on the other hand, that half a bushel of gypsum sown broadcast, in a rainy day, upon an acre of clover, will often very much more than double the crop. In this case, whatever may have been the effects of the lime, or whatever, in any case, may be the advantages of mixing lime with ashes, where land has been pared and burned, (and I am not disposed to deny them,) the advantages of consuming the crops of turnips upon the ground, by folding and feeding the sheep, are not matter of question. A high authority, on the treatment of land which is pared and burned, advises "to apply the whole of the manure produced by the crops to the ground; and to manage it, generally, in the usual course of regularly-cultivated arable land." This corresponds with the shrewd advice, to which I referred in a former number, given in respect to the application of a new artificial manure, which was, *that, in addition to the artificial manure, you should apply to the ground the quantity of other manure ordinarily used in such cultivation;* and somewhat reminds one of the mode adopted by the Irish servant, (an Irishman, of course,) whom his master desired to get rid of a light guinea, and who reported to him, with much selfgratulation, that he had done it most adroitly by passing it, unobserved, at the turnpike-gate, between two sixpences.

The paring and burning of peat land is always advised, and the ashes to be spread. Here there is an excess of vegetable matter, which, perishing under cold water, and that water usually impregnated with an excess of iron or some pernicious mineral substance, is in an unfit condition for the purposes of vegetation. The coarse grasses, likewise, customarily found upon peat meadows, forming a thick, matted sward, require to be either entirely removed, or thoroughly reduced and decomposed, before a better kind of vegetation can take their place. Peat ashes are stated to have a specific value, which I shall speak of presently. The burning of peat ground, however, requires very great care, as I have sometimes seen very deep and inconvenient holes made in the surface, by the fire having been suffered to proceed too far.

In all cases where it is attempted to bring a soil into cultivation by paring and burning, it is considered indispensable to success, that the land should be drained and laid thoroughly dry. This rule applies to other cases, besides those of paring and burning. I may, as well as not, here, though I shall have occasion to repeat it hereafter, urge upon farmers the importance of laying their land dry, or rather of having the command of the water upon it, in order to a successful culture. Without this, it is idle to expect success. Water, one of the great elements in vegetation, may, by excess, become thoroughly pernicious and destructive, except to those coarse aquatic plants to which it is the natural condiment and home.*

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* After writing the above article, I met with some remarks of the distinguished writer on rural economy, Boussingault, to whom I have before referred, which had not before met my eye, but which I know my inquisitive readers will be glad that I should present to them.

"The effect of the imperfect combustion of these pyritic turfs, the product which results from it, explains to a certain extent the beneficial effects of the practice of *paring* and *burning* — an important and widely-spread practice, the utility of which it would be difficult to understand, were it not connected in some way with the production of ammoniacal ashes.

"The useful effects of paring and burning are, in all probability, connected with the destruction of organic matter, very poor in azotized principles; in the transformation of the surface of the soil into a porous, carbonaceous earth, made apt to condense and retain the ammoniacal vapors disengaged during the combustion;

XCI. — BURNING LAND.

The burning of the soil is a process somewhat different from that of paring and burning, and, properly speaking, for different objects, though the latter process tends in some degree to the same end. No operation in husbandry, which I have seen this side of the water, surprised me so much as this. Of its expediency, or rather of its remunerative character, I must leave others to judge. In the last particular, the difference between two dollars a week for labor without board, and three dollars a week with board, will be found material. In either case, it will be found that there are few operations more expensive.

The question which an English farmer, or improver of land, often proposes to himself, is very different from what an American farmer in similar circumstances would propose to himself. The price of land in England is often most exorbitant, £60 sterling, or 300 dollars, per acre, being frequently paid for large farms, and, not seldom, much more than that. The annual rents paid in Great Britain for extensive farms would, in some

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lastly, by the production of alkaline and earthy salts, which are familiarly known to exert a most beneficial influence upon vegetation. These conditions seem so entirely those, the object of which it is to realize by paring and burning, that, in order to make the operation favorable to the soil which undergoes it, the vegetable matter which it has produced must of necessity be transformed into black ashes; when it goes beyond this, when the incineration is complete, and the residue presents itself as a red ash, the soil may be struck with perfect barrenness for the future. The burning, therefore, that was not properly managed, that led to the complete incineration of all the organic matter, would, for the same reason, have a very bad effect in the preparation of the Picardy ashes; which might, indeed, act in the same way as turf ashes from the hearth and oven, but which, deprived of all azotized principles, would not ameliorate the ground in the manner of organic manures."

"I have frequently seen the process of burning performed in the steppes of Southern America. Fire is set to the pastures after the grass which covers them has become dry and woody; the flame spreads with inconceivable rapidity, and to immense distances. The earth becomes charred and black; the combustion of those parts that are nearest to the surface, however, is never complete; and a few days after the passage of the flame, a fresh and vigorous vegetation is seen sprouting through the blackened soil, so that in a few weeks the scene of the desolation by fire becomes changed into a rich and verdant meadow." — *Rural Economy*, p. 374.

cases, almost buy the fee simple of lands in the United States, lands much more fertile, and, in the old and settled parts of the country, subdued, well fenced, and with good buildings. Where land now is waste, and produces little or nothing, it is obvious that it would be wiser to expend a sum equal to what would be the full value of the land after its improvement, than to suffer it to remain wholly unproductive; such improvements may, in fact, be considered as creating so much land, as adding so much productive land to an estate. In the United States, where land is abundant and cheap, such expensive improvements, unless on a small scale, and in some most favored localities, cannot be recommended. It would be wiser to abandon land so worthless, and have recourse to better soils, which are easily accessible for prices vastly less than the expense of such improvements.

The process of burning land, of which I am speaking, is applicable only to stiff, clay soils. The objects of it are, first, to render it friable, and destroy its adhesiveness, and the second is to create a supply of manure in the ashes of the soil thus burned. The first I can understand; the second seems more difficult of credence.

The process consists in digging, either with a plough or spade, the whole top-soil of a field, and placing it in small heaps, with a furnace or oven under them, where a fire of coal, or fagots, or brushwood may be kindled, and continue to burn until the whole pile is, properly speaking, reduced to an ash-heap, as far as the nature of the substance so reduced admits of being so designated. Where I have seen the process carried on, the depth of soil so dug and burned did not much exceed a foot; but I have been made acquainted with one experiment, where the depth so moved and reduced was three feet. Those of my readers who are fond of mathematical calculations may amuse themselves with calculating the gross number of tons of earth which, on a single acre, must be moved in such an operation; and I think they will be surprised at the result. I know of scarcely any thing like it, except in the case of the old man in the fable, who bequeathed to his two sons a valuable treasure buried in the field, for which they were to dig. Whether avarice or curiosity prompted them in the case to go deeper than this, and to accomplish a more Herculean task than this, we are not informed.

In one case, which I saw, the pieces of clay were baked into hard lumps; and a good deal was completely vitrified, the whole presenting the appearance of the floor of a brickkiln after the burned bricks had been removed. The process here had evidently been carried too far, and the experiment disappointed the enterprising undertaker — a failure, for which he suggested many causes besides the true one. I have always found that the strong back — for very strong it must be to bear all that is put upon it — of a certain nameless personage in theology was an exceedingly convenient repository for certain persons to put their sins upon, which their own inordinate self-esteem would not allow them to ascribe to the proper source; so my friend, in this case, had half a dozen reasons to give respecting the season, and other extraneous hinderances, in place of the true reasons why his experiment failed; and, like a brave veteran, the hero of many fights, in the midst of his discomfiture, his heart still glowed with the confidence of ultimate success. Such courage and perseverance deserve a better reward than I fear he will obtain. There are some chemists, learned in the highest degree, who speak with confidence of pounded glass being used as a manure; and another, eminent in his peculiar science, speaks of the power of a plant, in its wonderful action of growth, to decompose the sides of the glass vessel in which it is grown, and appropriate portions of it for its nutriment. I believe it. He is a brave man who will presume to say what cannot be done. A single imprisoned drop of water, by the power of fire or of frost, may rend a mountain asunder. The power of vegetable action is as tenacious and indomitable as the Creator could make it, for the purposes for which he designed it; and it is only another form in which that wonderful Power, which can command stones that they shall be made bread, displays itself, that enables the plant, which is itself to become bread to man, to extract, even from the inert stones themselves, its own proper nutriment and substance, and convert them into a principle of life.

I do not know where better than in this place to insert a letter received from a most intelligent and practical farmer in Staffordshire, which will be read with interest, and which relates particularly to this mode of improvement.

"I fear it will not be in my power to give you any satisfactory or decisive information as to the result of burning the Needwood Forest clay sand. What I have done has not been by paring and burning the surface, which is, I believe, pretty extensively done in some parts of England. In that case, I presume, a great portion of the substance burned is vegetable matter, which almost of itself furnishes the fuel for burning the soil. I have ploughed up a fallow-field as deep as the plough would go, perhaps a foot deep, of which three or four inches were clayey soil, and the rest pure clay, and have then with coal-slack burned the whole in small heaps, or in rows. This is the third season since it was done; but the two which have elapsed have, from drought, been extremely unfavorable for the cultivation of land out of which every particle of moisture had been burned."

"I have also very imperfectly succeeded in having the burning effected as I should have wished. The clay breaks up in large, rough, solid lumps, and it is extremely difficult to subject the whole to the action of fire, without having a large portion of it reduced to brick, or brick-dust. Under the most favorable circumstances this is difficult, and the difficulty is constantly increased by weather. A violent wind drives through the heaps, rapidly consumes the fuel, bricking the clay in contact with it, and leaving the rest untouched; or a soaking rain, for a day or two, interferes equally unfavorably. The object, I presume, should be to get the fire to smoulder through the whole mass, which no doubt would be more easily effected if it were somewhat of a more loamy character, and had any tendency in itself to carry on the action of the fire."

"In 1843, I had a very full crop of barley from the first half acre, which was burned and spread down early in the spring, and received a good soak of rain. From the next portion I had a very bad crop of potatoes, and from the rest of the field a poor crop of turnips, which were sowed very late, and, from want of moisture, did not come up till they should have been half grown. They were a healthy crop, but very small. Last year I sowed barley, which came up very partially, from want of moisture; and in June, I ploughed it up and sowed turnips, which in all this part of the country (as well as in that field) were, last year, (1844,) a complete failure. These two years of non-return from the burned land indisposed me to try it for another without the aid of manure. I dunged it, and have now on one half a good growing crop of oats, and on the other a beautiful crop of wheat.

One land of the wheat was left without manure. It was worse than the rest, but not bad. In the *working* of the land a *vast improvement* has been effected by the burning. I sent specimens of my unburned and burned clay to be analyzed by Professor Johnston, in Edinburgh; who wrote to me, after the analysis, that he was quite unable to assign any chemical reason for the fertilizing effects attributed to it. I told him that I had not any experience myself of its fertilizing effects; and I then sent him specimens of clay, burned and unburned, from Newhall, a colliery distant about seven miles from this place, where I have been shown fields, which are said to have borne six and seven successive luxuriant crops without a particle of manure, after being burned, having previously been exceedingly unproductive. The clay is in appearance very different from mine, and burns into a very different substance, apparently not having any tendency to burn into brick, but into black and red loam. I have not yet received Professor Johnston's report upon them."

"In the last two years I have burned a great deal of clay, but it has been under different circumstances, and with different objects. In draining my land, nearly the whole material taken out is pure clay, which I consider unfit to be put in again, in that state, over the tiles. I therefore burn it, and then fill the drains with burned clay, of which about one half then remains, which I cast upon my plough-land to improve its texture, in which way I find it very useful."

Experience is always a valuable instructor, when that experience is intelligent, and carefully detailed. The letter which I have given is, on every account, entitled to respect. I shall proceed to give some other details from another source, the Journals of the Royal Agricultural Society.*

Mr. Charles Randell, who speaks of having had much experience in the improvement of cold and heavy soils, by the application of burned clay, has given the particulars of several experiments of this nature.

The first was made with a field of eleven acres of the worst description of clay on the side of a steep hill, "inaccessible to the dung cart, to which it had always been a stranger." It was ploughed in the summer, and he, with the scuffle and drag, brought the clods of couch grass and wiry turf to the surface, which, with the quantity of soil necessary to procure a good dressing of ashes, were shovelled and forked together, and burned in heaps of about a cart-load each, with wood from the neglected hedge-rows in the vicinity. The weather, he says, was unfavorable, and the work not well done, but the result was satisfactory. The field, after the ashes were *lightly* ploughed in, was planted with vetches, and these were eaten off the succeeding summer with sheep, and then planted with wheat, which produced more than thirty bushels per acre. It was afterwards laid down to grass, and carries a much heavier stock than before. He says "that, if he finds it go back, he shall plough it again for vetches, having no doubt that it is now capable of bearing a crop sufficient, when consumed upon the land by sheep," (I beg my readers particularly to remark this qualification,) "to enable it to grow as good a crop of wheat as the last."

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* Vol. v. part i. p. 113.

His next trial was upon a field of sixteen acres, fifteen of which are a strong clay, the remainder fair turnip land. The clay part of the field was exceedingly foul, so that he had two objects to attain — first, to get rid of the couch by burning it in the clods; next, with the ashes so obtained, to render the whole field capable of bearing a crop of swedes. In this case, likewise, he speaks of his success. " The whole, after draining, was limed and manured alike, and the crop was quite as good upon the clay as upon any part of the field. All the swedes were consumed upon the land by sheep; the succeeding barley crop was much better upon the part which had rarely, if ever, been planted with barley before; the seeds (that is, the grass seeds) were equally good; but the wheat crop this year, (1843,) from the excessive growth of straw, went down early, and became mildewed, and, though more bulky than the rest of the field, will not be so productive. The field is now ploughed for swedes again; and the clay part is as healthy, and as likely to grow a crop, as that which has always been considered turnip land."

It will not escape observation, that this land last mentioned was drained, and limed, and manured, and all the swede turnips consumed upon it by the sheep, who were, of course, folded upon it. This certainly cannot be considered as niggardly treatment of the land, whatever may have been the effects of the burning.

Two other fields are mentioned, in order to show more satisfactorily the fertilizing power of ashes, because, to use his own expression, they were not assisted by any other kind of manure. What Mr. Randell means by not being assisted with any other kind of manure, will appear from his account. The field of five acres was a foul bean stubble; the English horse-bean is undoubtedly intended, which, when not cut close, leaves a large amount of stubble. In May, it was skim-ploughed to the depth of about one inch and a half, and all that the plough raised burned with fagots, and the ashes spread. It was then ploughed and scuffled, and rendered perfectly clean; planted with vetches in October; and fed off, the ensuing summer, by sheep folded upon it; and this followed by wheat at more than forty-five bushels per acre. Another field adjoining, of three acres, under similar treatment, produced *nearly equal results*, the difference in the wheat crop, which was *not quite so heavy*, being attributable to the vetches having been eaten off by horses tethered on them, instead of sheep. The difference of the results in the two cases — of feeding with sheep on the ground, or with horses — is quite worthy of remark; but it is much to be regretted that the amount of difference should not have been exactly ascertained, instead of adopting the terms, "nearly equal results," and "not quite so heavy," which imply that the result was matter of conjecture, not of measurement, or at least admit of considerable latitude of construction.

Another experiment of the power of ashes, unaided, to restore exhausted land, (more conclusive, he says, than the former,) was a field of ten acres of exceedingly stiff clay, "in 1839, an awfully foul piece of two years old in grass." He ploughed and planted it with wheat, which was dibbled in, and twice hoed, and gave only sixteen bushels per acre. Afterwards the stubble was skim-ploughed, and attempted to be dragged, but so matted and heavy, it would seem, that this was found impracticable; "it was then parted with forks, and burned; and the quantity of ashes burned could not have been less, upon the far greater part of the field, than from 150 to 200 yards per acre." What is meant by yards, in this case, I must leave it to my readers to conjecture, — I suppose, however, cubic yards. It was then planted with vetches; but such a crop of crowfoot, charlock, and rubbish of all descriptions followed, that it was mowed and carried to the fold-yard. It was then fallowed and drained, and then, in the ensuing spring, sowed with barley, which produced fifty-six bushels per acre.

The next field consisted of thirteen acres of stiff, but tolerably productive wheat land. It was foul, burned equally well, was drained, limed, and manured, and produced an excellent crop of swedes, no turnips having been grown upon it before. "It has since grown barley and seeds, as good as I could wish," rather an indefinite mode of measurement, "and is now planted with wheat."

All these pieces of land had the ashes burned and spread upon the land, with wood cut from the adjoining hedges, or with inferior coal, and the cost of the process estimated at £3 10 s., or about $17, per acre.

In another case, the same farmer adds, "upon fifteen acres, which were dressed in like manner during the winter, where no attempt was ever before made to grow turnips, in consequence of the tenacious quality of the land, and without the aid of manure of any description except the ashes, and I have had a very excellent crop; and the most extraordinary part of the matter is, that, although the greater part has been eaten off in the months of October and November last, which were very wet, by nearly four hundred sheep, constantly kept upon them, the nature of the soil has been for a time so changed by the ashes, that I have been enabled to plough close behind the sheep, and drill the wheat as fast as ploughed."

He remarks, likewise, what I deem of much importance, that, if the soil be dug and "thrown with the spade in large pieces, a double quantity of coal will be consumed, and the ashes of no more value than so many brick ends. The proper mode is to move the soil with a pickaxe, breaking it all the time as much as possible; it is then put lightly on the fires with a shovel."

What he says of the value of ashes is quite worthy of attention. "That the mechanical effect of ashes, in rendering heavy land friable, has a great deal to do with increasing its powers of production, there can be no doubt; but it is unfortunately as certain, that their effect in this way is not so great in subsequent years as in the first two or three, though it will always be considerable. This is accounted for by the natural tendency of ashes, like lime, to sink into the soil. In a few years, they become incorporated with a larger proportion of earth than at first; and their effect in rendering it more easily workable then gradually diminishes; but that their virtues are not to be attributed to their mechanical effect alone, I have proved by wheeling ashes upon the surface of part of a crop of vetches, when the part so dressed showed, in the succeeding spring, a superiority which was distinguishable as far as the field could be seen, and where the crop was cut (green) while the whole was heavy, that part to which the ashes were applied was completely rotten at the bottom."

"For those who, like myself, have to get a considerable tract of foul and poor clay land into a tolerable state of cultivation, there are, to my knowledge, no means by which it can be accomplished in so short a time, and with so great a certainty, as by burning. Let it be accompanied in all cases by draining; let the first crop be a green one consumed upon the land, and the land will be at once established, and may ever after, at the least possible expense, be maintained in a productive state, provided it be kept clean, and cropped in a fair and reasonable manner."

We have likewise, in this case, the testimony of Mr. Eli Tabrum, who speaks of having practised the burning of land for thirty years, and of having made it a regular course of farming. He commences on the land by sowing ten to twelve pounds of the best trefoil seed, and from four to six pecks of rye-grass per acre, on the exhausting wheat early in the spring, having it harrowed and rolled in, the expense of which is amply repaid by the autumn and spring feed it produces, enabling a much larger flock of sheep to be kept. There is a twofold advantage in being liberal in the quantity of seed sown; that is, in the quantity of feed, and in the increase of herbage, which materially assist the burning, and much improve the quality of the ashes. It is highly necessary to have the land well underdrained before burning. He adds, afterwards, that if the cultivation "is followed up by effectual burning, about once in six or eight years, with an intermediate coat of yard manure, or folding, it would double the returns of much of the land of which he speaks, both in stock and crops.

Another farmer, Mr. Eli Turvill, speaks of burning land as much practised in his vicinity. "The fuel generally used is a good wagon-load of haulm per acre, or brushwood from the hedges, and a portion of bean-straw. Some burn the heaps at

4 perches square, 40 per acre, and each heap is expected to contain three yards of ashes; some in heaps, at 8 yards square, at 75½ per acre, and each heap is expected to contain two yards of ashes. The whole of the ashes are spread, and the land fallowed in the usual way. It is repeated every four or six years, as may suit the rotation of crops. It is an excellent preparation for all kinds of corn, (wheat, barley, &c.;) on the thin-skin land, white turnips are grown well after burning; it absorbs the water; the land dries earlier, and can be sown sooner in the spring. The improvement on the crop amply pays for the outlay, as well as leaving the land much better for the following crops. Burning is a fertilizer of the soil, and the oftener it is burned, the more it improves the staple and quality of the land; so far from destroying the soil, it acts greatly to its improvement, and is highly conducive to the growth of the cultivated crops; the effects may be seen more particularly in the clover." *

Such are the accounts of practical farmers, on this important process. Let us now hear what lessons science inculcates in relation to the subject.

Dr. Playfair, the learned consulting chemist to the Royal Agricultural Society, says, —

"By this process of paring and burning, injurious organic matter is consumed. Plastic clays are quite changed in their character, not only by having all their constituents brought into contact with the oxygen of the atmosphere, and thus undergoing change, but the clay itself acquires another character; it becomes absorbent, taking up from the atmosphere ammonia, carbonic acid, and watery vapor, as well as affording more ready access to the nutritious substances which may be dissolved in water. But in this you see *nothing is destroyed*, and the inorganic elements of the soil are only brought more fully into contact with the absorbing organs of the plants." †

We may next refer to the great agricultural oracle, Professor Liebig, on this subject.

"The advantage of manuring fields with burned clay, and the fertility of ferruginous soils, which have been considered as facts so incomprehensible, may be explained in an equally simple manner. They have been ascribed to the great attraction for water exerted by dry clay and ferruginous earth; but common dry, arable land possesses this property in as great a degree; and, besides, what influence can be ascribed to a hundred pounds of water, spread over an acre of land, in a condition in which it cannot be serviceable either by the roots or leaves?

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* Journal of Royal Agricultural Society, vol. iv. part 1, p. 267.

† Lecture before the Royal Agricultural Society.

"The true cause is this: The oxides of iron and alumina are distinguished from all other metallic oxides by their power of forming solid compounds with ammonia. The precipitates obtained by the addition of ammonia to salts of alumina or iron are true salts, in which the ammonia is contained as a base. Minerals containing alumina, or oxide of iron, also possess in an eminent degree the remarkable property of attracting ammonia from the atmosphere, and retaining it. Vauquelin discovered that all rust of iron contains a certain quantity of ammonia. Chevalier found that ammonia is a constituent of all minerals containing iron; and that even hematite, which is not at all porous, contains one per cent. of it. Bouis showed, also, that the peculiar odor observed on moistening minerals containing alumina is partly owing to their exhaling ammonia. Indeed gypsum, and some varieties of alumina, — pipe-clay for example, — emit so much ammonia, when moistened with caustic potash, that, even after they have been exposed for two days, reddened litmus paper held over them becomes blue. Soils, therefore, which contain oxides of iron and burned clay must absorb ammonia — an action which is favored by their porous condition. They further prevent the escape of ammonia, once absorbed by their chemical properties. Such soils, in fact, act precisely as a mineral acid would do, if extensively spread over their surface; with this difference, that the acid would penetrate the ground, enter into combination with lime, alumina, and other bases, and thus lose in a few hours its property of absorbing ammonia from the atmosphere. The addition of burned clay to soils has also a secondary influence. It renders the soil porous, and therefore more permeable to air and moisture. The ammonia absorbed by the clay or ferruginous oxides is separated by every shower of rain, and conveyed in solution to the soil."*

I have gone thus at large into the subject of paring and burning land, and of burning clay, and the value of the ashes of clay, deeming that it would at least be found interesting to my American readers, where the process is certainly rare, if not unknown, excepting on peat lands; and because, likewise, it is a process belonging to English agriculture; but not with any strong expectation of its being adopted to any great extent in my own country, where land is cheap and labor is dear.

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* Liebig, Agricultural Chemistry, Boston ed. p. 102.

The scientific solution of the operation of burned clay, and of ashes generally, I submit to those who are interested in, and competent to deal with, such discussions. The practical farmer will not fail to observe how much stress is laid in every case, with scarcely what may be called an exception, on the quantity of vegetable matter consumed in the burning, and going to increase essentially the amount of ashes to be applied. He will not fail to observe, likewise, the connection, in some cases, with the burning, of liming, manuring, and folding sheep upon the land, and consuming the produce grown *upon it.* If he should undertake to burn his soil, it is hoped that his attention will be specially arrested by these points. The value of ashes, the ashes of consumed vegetable substances, is not a thing now to be learned; and how much soever pains may be taken in burning clay, it is quite safe at present to assume that the more of vegetable matter is consumed with it, so much the better for the ashes of the clay. The opening of clayey and adhesive soils by burning them, so as to make them easily worked, and rendering them accessible to air, and moisture, and light, and heat, is an obvious and decided advantage. In their ordinary condition, the cultivation is a work of great labor.

The burning of the grass and rubbish upon the American prairie grounds is always followed by a thickening, and increased luxuriance, of the succeeding crop. This burning, however, rarely does more than skim the surface, and, except in cases of excessive drought, does not destroy the roots of the herbage. The burning of the fallen trees in the new parts of America, and the successful culture of crops upon their ashes, I have already referred to. In the management of broom corn, (*sorghum saccharatum,*) on Connecticut River, a crop which leaves a large amount of haulm, many farmers have long been accustomed to burn the stubble upon the ground for the sake of the ashes, rather than either plough it in, or carry it into their barn-yards to be added, in its decomposition, to their manure heaps, or to take pains to cure it, and use it as feed for their stock, for which, when saved in a proper condition, it is as good as the stubble or stover of Indian corn, (*zea mays.*) The farmers of Long Island, New York, have for years been in the habit of sending to the towns on the sea-shore in New England, for the purchase of the spent or waste ashes from the soap-boilers and others, and for which they pay what is deemed a high price. They apply it to their wheat lands, sown broadcast upon the young wheat, and say that, without it, they are not sure of a crop. The farmers in New England err in allowing it to be taken from them at any price, unless they can find a substitute in guano, or some other manure as portable. I speak of these facts, however, as showing the universally admitted value of ashes as a manure, a subject to which I shall refer again, when the important subject of manures is treated, as designed.

XCII. — ADMIXTURE OF SOILS.

One of the most common and obvious suggestions, in the improvement of the soil, is that of rendering, as far as practicable, plastic and adhesive soils free and permeable; and, on the other hand, that of making those soils, which are loose and light, close and compact. In the former case, in order to effect the desired object, draining has been applied with great success, and must be regarded as the basis of such improvements. Without draining, indeed, and a complete riddance of the superfluous wetness and moisture, little is ever to be hoped for in any case. In order to effect the latter object, rolling with heavy rollers, and especially treading with sheep, have been resorted to; and several farmers, with whom I have had the pleasure of forming an acquaintance, abandon all expectation of a crop, unless the ground, after being sown, is thoroughly trodden by sheep, which treading, for the purpose specified, may be considered even as more effectual than the application of the roller.

But an improvement of a more substantial and permanent character is attempted by what may be termed an "admixture of soils;" by the addition of clay to sandy soils, and of sand to clayey soils. In agricultural books and addresses, I have often seen this method recommended, with a great air of sagacity and confidence, as an obvious process of improvement, of very easy accomplishment, by persons who understand little of practical agriculture, and very imperfectly appreciate the difficulties of such a process. The transportation of soil is among the most expensive operations in husbandry, and can scarcely be expected to be carried on, on a very extensive scale. To convert a clayey soil into a siliceous soil, or, on the other hand, a siliceous soil into a clayey soil, so as deeply and permanently to change their character on any extensive surface, must be left to those great geological changes which are alike beyond human prescience, command, or control. Amendment, rather than change, is all that human skill and ability are likely to effect; and I shall detail in this matter such examples as have come under my observation.

The application of sand to clay, like the application of sand to lime in the making of plasterers' mortar, has, in general, especially if the clay is wet when the sand is so applied, a tendency to give it hardness, rather than to render it friable and open. Where the land is in a state of dryness, and newly ploughed, the application of a limited quantity of sand might serve to render it more open. That this would be the whole effect to be expected from it, and this to a degree uncertain, and that it would effect no chemical alteration in the soil, seems generally agreed. That a portion of silica is essential in the formation of all the cereal plants is established; but in all clays there is presumed to be a sufficiency for this purpose. In peat lands it may be otherwise. A distinguished practical and scientific farmer, the late Mr. Rham, states that he has never known an instance in which the application of sand to clayey soils has been found to succeed in rendering them more porous. The expense of laying on the large quantity of sand that would be required must probably swallow up any profit that could be derived from it. Mr. Pusey, however, showed me an example in which a clay land field in grass had been decidedly benefited by a top-dressing of sand from a neighboring hill. Whether the sand, in this case, had any peculiar chemical properties, from which the benefit of the application was derived, did not appear.

It is not so, on the other hand, with the application of clay to light soils; and this has been practised in England so extensively, and with so much success, that I shall detain my reader with some prominent examples. Of the application of clay in the improvement of peat lands, I shall speak presently; I now refer only to its application to sandy and light lands, with a view of giving them compactness. The object of applying clay, indeed, may be twofold; the first to produce a closeness of soil; and the second, that of obviating their too great dryness, the property of clay being to absorb and retain moisture both from the atmosphere and that which falls in rain.

One of the most extensive applications of it, which I have witnessed, was on the farm of the Duke of Bedford, at Woburn, a place distinguished, under the care of its present noble possessor, as under that of his eminent predecessor, for a most intelligent, scientific, extensive, and successful husbandry; in all its various arrangements, and the completeness and extent of its operations, surpassed perhaps by no one in the kingdom, or hardly, indeed, rivalled.

The intelligent manager of the place, Mr. Burness, states that he finds "the application of clay to his light soil of great advantage. It makes the straw much stronger, with a better ear, and standing much better up in wet seasons. When the land is highly manured, without being clayed, the crops are liable to fall down, become lodged and spoiled." He adds, likewise, that he finds claying of great advantage to the turnip crop.

The practice is to put the clay on the clover leys as early as the crop is off, and get it broken in pieces as much as possible before the land is ploughed for wheat. It is also laid on land that is under fallow for turnips early in the winter, that is, on land which has been ploughed preparatory to its being cultivated in turnips the ensuing season. This is done that it may have the chance of the winter and spring frosts to become well pulverized before it is ploughed down; and this he prefers to spreading it upon clover leys.

He goes on then to speak of some experiments. "We clayed last summer four acres, and left two acres not clayed on an old sward and light soil. The clay was put on in July, and lay all the summer; was ploughed up in November, and pressed," (an operation which I shall describe presently,) "and the wheat dibbled into the pressed grooves. In February, we top-dressed the six acres with good farm-yard dung; and, as late as the beginning of May, I thought there would not be half a crop, although plenty of ends; but toward the middle of the month the clayed part began to look of a much darker appearance than the two acres which were not clayed; and, at the present time," (when he gave this account,) he thought, "there was one third part more on the clayed than on that which had not been clayed, although managed in every other way the same."

He goes on to say that, in January, 1841, he clayed some land which was going to be a turnip-fallow the following summer; and in the month of April, when he began to harrow and plough the land, the clay broke down and slacked like lime, and worked in with the soil. There was not much apparent difference in the turnip crop that summer, as the other part of the field was sown at a different time, and he was not able to tell the difference; but the ensuing year, he says, "the barley looks much stronger and stiffer in the straw, and stands much more upright, than in the land which was not clayed, where the greater part of the crop is down on the ground, and exposed to be rotted by the rain."

The quantity applied to the acre is generally about fifty loads; I suppose single-horse cart-loads are meant. If more is to be applied, it is advised to make the application at successive times, as, in his opinion, more given at once would do harm. Nearly all the light soil on the farm of the Duke of Bedford, near Woburn Abbey, has been clayed, and a great deal of it twice; and, in every instance, its beneficial effects have been established. I myself can bear witness to the neatness and excellence of the cultivation, though I had not the pleasure of being there when the crops were standing upon the ground. The clay may be dug from the pit at any time most convenient for the farmer, and, if turned over once or twice, will mix much better with the soil, though, of course, the expense of the operation must, in such case, be increased. Mr. Burness says, his plan is to dig and cart it on to the field at once.

Mr. Pusey is of opinion that this substance, denominated clay, contains a great deal of lime, and is, in fact, a stiff marl.

Another eminent Bedfordshire farmer, whom I have the pleasure of knowing, speaks of the application of clay or marl, customary in his neighborhood, as varying from 50 to 150 cubic yards per acre. He deems the smaller quantity preferable at one operation, as it mixes more steadily with the soil, and, though it may not last so long, comes sooner into operation. He has applied it to clover leys in summer, and to turnip fallows at different times. He advises to have it dug in winter, and to cast it upon the turnip land in the spring, when it has had time to dry, and has become lighter of carriage.

We have the testimony of another skilful farmer, a tenant of the Duke of Bedford, who has pursued the practice of claying land to a great extent. Not satisfied with the quality or quantity of his produce, he has clayed 420 acres, in every instance with good effect. Upon the gravel and sand land he has put forty loads per acre, containing forty bushels per load. On the moorland, covered with rushes, he has put seventy loads. The time of applying it is directly after harvest, or in winter, if there has been a frost. At the former time, it is done with less labor to the horses and less injury to the land. The clay gets dry, and, as soon as rain comes, it may be harrowed about, when, according to his opinion, it will begin to act beneficially to the land by correcting the acidity, of which most lands have too much, thereby making food for plants of what was inert in the soil, and giving the land that solidity which it required. In one case, he speaks of witnessing the decided advantages from it, after a lapse of fourteen years from its application. He speaks further of having both marl and clay upon his land. He tests their different qualities by applying vinegar, and determines their goodness by their effervescence. In the case above referred to, the clay which he applied would not effervesce on the application of an acid; but, on drying it before the fire, and then applying the vinegar, he found the desired result. This determined him to use it on the land, giving it all the benefit of the sun in summer.

In another case, he applied, in September, 1835, seventy loads per acre of marl, blue, with some chalky particles among it, upon seven acres, and left seven acres adjoining unmarled. The next year, the oats were very good where the clay was; the succeeding year, with turnips, the crop was good where the land had been clayed; on the other land the crop appeared, and soon perished. In 1840, the whole field was clayed, and a large crop of barley was obtained throughout. He remarks, "that land will not always show the benefit in the first crop after the application. Some farmers," he says, "prefer lime to clay, on light land." He deems this an error. Lime will correct the acidity in such land, but it does not give solidity or compactness to the soil, but makes light land still lighter. Besides the advantages to which I have above referred, he considers the application of clay as serving to strengthen the straw of wheat, and to increase the quantity and improve the quality of the grain; and likewise — certainly a most material point — to prevent mildew in wheat, to which the farm was formerly subject. He is of opinion, likewise, that it prevents a disease to which turnips are subject, called, vulgarly, *fingers and toes*, which I think is more doubtful; and that it supplies to the soil an element favorable to the growth of clover, of which I believe there can be no question.

It may be thought, in this case, that advantages may arise from the application of marl — in which, of course, there is a considerable portion of calcareous matter, more active than the aluminous element — which are not to be expected from the application of pure clay. This would probably be the case; but I have seen repeated examples of the application of pure clay, both spread upon grass land, as a top-dressing, and otherwise applied, which have been highly beneficial; and where the material is at hand, and can be procured without a heavy expense, the practice may be confidently recommended.

On the farm of Mr. Pym, in Bedfordshire, a very skilful and practical agriculturist, "the whole farm," Mr. Pusey says, "which is a light yellow sand, and which was covered with heath and a gray lichen, the gray moss of trees, — a kind of vegetation indicating a great degree of sterility, — the whole farm has been made fertile by means of a dark gray clay, which is full of lime, situated at the foot of the sandy hill, and the moderate dose of sixty cart-loads per acre is found to last at least twenty years. On this sandy farm, both turnips and swedes were ridge-drilled, and looked remarkably well."

This practice of marling or claying light land has been long and most extensively practised in the county of Norfolk, a county which yields, perhaps, to no other in its agricultural improvements, which was the residence, and the scene of the labors and improvements, of that acknowledged prince of farmers, Mr. Coke, (the late Lord Leicester,) of Holkham, and which now presents, as

I have had the pleasure to witness, some of as good examples of intelligent, exact, and successful farming as are to be found in the United Kingdom. In the cases of marling, to which I shall refer, while the upper stratum, or surface, is light and sandy, yet there is found, at not a great depth, a deposit of clay or marl, which is proved to be highly beneficial, and which, from its being so accessible, is applied easily, and at a moderate expense.

The substance applied is a bluish clay, and found from four to six feet under the surface. Pits are dug, about six feet by three, in rows, in a part of the field most convenient for the application of the material, and least inconvenient on account of the injury done to the fields, and two or three spades' depth of the clay is taken out; the top soil, which in many cases is peat, being thrown back into the open pits. The whole piece thus dug over is sometimes converted into a plantation, where, the roots of the trees extending themselves, and the ground being covered with the waste of the trees, the soil thus dug over becomes consolidated, and ultimately brought into a condition for use.

In most parts of the country, and universally where the land is inclined to wetness, at least before the introduction of Mr. Smith's system of under-draining and subsoiling, in which all cultivation in ridges is disapproved of, fields are cultivated in beds, or, as they are here called, *stetches*, varying in width from six furrows to thirty. The practice of one farmer, in Norfolk, whose admirable cultivation is second to none, I have had the pleasure of observing, is to plough two of these beds outward, leaving a deep trench, or wide double furrow, in the centre, and here, where the clay is near the surface, obtaining it to spread upon the land. In the instructive Report on the Agriculture of Norfolk, published in the Journal of the Royal Agricultural Society, an account is given of one enterprising farmer in Norfolk, who had applied 54,055 loads to a little more than 286 acres of land, or at an average rate of 189 loads per acre. In another case, a farmer clayed a thousand acres twice over, at the rate of forty loads per acre, in the course of eight years. Another farmer applied at the rate of fifty loads per acre. In another case, a great improvement has been effected by trenching, so as to bring the bottom soil to the top, and bury the top at the bottom. "In this case a trench is opened three or four feet wide, and two spades deep; the bottom of the trench is then turned up with a spade or three-pronged fork." The surface earth is then thrown back, and a complete inversion of the soil takes place.

In some cases, men are employed, at a season when labor is to be had most cheaply, to marl or clay the lands with wheelbarrows, where the material is near at hand. The nearness of the material to be applied, its quality and abundance, and the price of labor, are all elements to be taken into the calculation, where any such improvements of land are to be undertaken, as well as the return to be expected, and the value of that return, when obtained. I give in this case no accounts, which are stated, of the actual or probable costs of such improvements, because little or no practical use could accrue from such calculations in the United States, where the price of labor and the value of produce are so entirely different from what they are here.

The application of chalk to the improvement of land is often and successfully made; but, as I know of no deposits of chalk in the United States, such a process can have little interest with us. I have already referred to the practice, in Lincolnshire, of chalking liberally chalk lands, or lands with only two inches or more of decayed vegetable matter or soil, underlaid by pure chalk. The same practice prevails in Hampshire; but I know no satisfactory reason to be given for it beyond that of giving closeness and adhesiveness to the loose and light surface soil. The effect of chalk is to bind land, without increasing its weight. The same may be said of lime, and of mixtures of lime with clay, as in calcareous marl. Though we have no deposits of chalk in the United States, yet we have an abundance of lime, and without doubt much calcareous and rich marl, yet to be discovered. The green sand of New Jersey, underlaying a large portion of that arid and siliceous soil, and extending along the eastern shores of Virginia, has already, in some cases, effected wonderful and valuable ameliorations, and those too of a permanent character; and when its ultimate, and, if I may so say, its moral as well as its chemical influences are considered, may be deemed much more valuable than an underlaying of gold dust.

Of the chemical influences of clay upon the soil, as yet, but little seems determined. "Potash," says Liebig, "is present in all clays; according to Fuchs, it is contained even in marl; it has been found in all the argillaceous earths in which it has been sought. The fact that they contain potash may be proved, in the clays of the transition and stratified mountains, by simply digesting them with sulphuric acid, by which process alum is formed. Land of the greatest fertility contains argillaceous earths and other disintegrated minerals, with chalk and sand in such a proportion as to give free access to air and moisture."

The remarks of Boussingault on this subject are, in my opinion, well worth giving to my reader. "The qualities which we esteem in a workable soil depend almost exclusively upon the mechanical mixture of its elements. We are much less interested in its chemical composition than in this; so that simple washing, which shows the relations between the sand and the clay, tells, of itself, much more that is important to us than an elaborate chemical analysis. The quality of an arable soil depends essentially on the association of these two matters. Sand, whether it be siliceous, calcareous, or felspathic, always renders a soil friable, permeable, and loose. It facilitates the access of the air and the drainage of the water; and its influence is more or less favorable, as it exists in the state of minute subdivision, or in the state of coarse sand or of gravel. Clay possesses physical properties entirely opposed to those of sand. United with water, it forms an adhesive, plastic paste, which, once moistened, becomes almost impermeable. With such characters, it will easily be conceived how it is impossible to work to advantage a soil that is entirely argillaceous. The proper character, or, if you will, the quality of soil, depends, then, essentially on the element which predominates in the mixture of sand and clay that composes it; and between the two extremes, which are alike unfavorable to vegetation, viz., the completely sandy soil and the unmixed clay, all the other varieties, all the intermediate shades, can be placed." *

An account is given in the Journal of the Agricultural Society of the application of bituminous shale to land, with very beneficial effects. This shale may be considered as an imperfectly-formed coal, a slaty stone, which is found on the opening of coal quarries, and is generally deemed an indication of the neighborhood of coal. A quantity of this substance had been thrown out

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* Rural Economy, p. 266.

in digging a watercourse. An application was made, by the tenant to the landlord, for an allowance for removing this shale, which incumbered the land. The owner, upon examining the spot, found around each heap a circle of dark green and luxuriant grass, such as would have surrounded a heap of rich manure, and observed that the frost was reducing the shale to powder. These circumstances indicated a fertilizing property in the substance, and he recommended to his tenant to apply it to the land. The result of such an application was a heavy crop of hay, and after-grass.

I am mainly induced to quote this account for the sake of showing the beneficial results often to be expected from experiment and observation. It is too frequently that we neglect valuable resources within our reach, as this farmer, in truth, proposed to remove and throw away that which proved a beneficial manure; and the casual glance of an eye accustomed to observation perceived its valuable but hitherto unknown properties, from the luxuriance of the growth of the grass around the edges of the heaps. Mrs. Barbauld, in her admirable lessons for children, presents a striking contrast between two boys taking a walk, one with his eyes open to see every object as he passed along, and the other sauntering along, as it were, with his eyes closed, without observing any thing. The moral of such a story is quite obvious. It would be of use to many others than children, who might find the means of all sorts of improvement constantly within their reach, if they would look after them, where now every thing appears barren and hopeless, and not go through the world with their eyes closed, or blind through stupidity or prejudice.

XCIII. — IMPROVEMENT OF PEAT LANDS.

The improvement or redemption of peat lands is the topic upon which I shall next treat. This subject essentially concerns the farmers of the United States, as, in many parts of the country, there are extensive tracts of peat land, now producing nothing valuable, which might be made eminently productive, as advantageously to the health of their vicinity as to pecuniary profit. Upon a small scale, great improvements have already been made, in this way, in several parts of New England, within my own knowledge, with a skill, intelligence, and success, highly honorable to those persons who have accomplished them.

One of the greatest enterprises of this kind, probably, ever undertaken by individual effort, was that of Lord Kames, sixty or seventy years since, at Blair Drummond, in the neighborhood of Stirling. This was not an improvement of the peat soil, but an actual removal of it. Underlaying the peat was a bed of deep and rich alluvion. From the walls of peat, or the cuttings which appear at the sides or bounds of this improvement, — for, though an immense body was taken away, an extensive tract is still to be found, — the depth of peat removed, as it appeared to me, must have been six feet or more. It is stated to have been in some places full sixteen feet. It was necessary to obtain a command of water sufficient to carry the turf into the River Forth. A wheel twenty-eight feet in diameter, and eight feet wide, was employed to raise the water, which it did at the rate of six and a half tons per minute. The water thus raised was directed into channels cut in the moss, along the sides of which men were stationed, cutting the moss into pieces, and tumbling it into the current of water, by which it was floated into the river, and thence much of it into the sea.

This was really a vast undertaking. Whether the expenses were met by the advantages gained, I am not able to say; but a large tract of most excellent land was uncovered and brought into cultivation, and which, as I had the pleasure of witnessing, now yields as good crops as are ordinarily grown in the country.

Enterprises of this nature must, of course, be rare, and in but few circumstances practicable; but such a work does infinite honor to the boldness which conceived, and the perseverance and labor which executed it. The interesting and extremely picturesque neighborhood of Stirling is all classic ground, made memorable by acts of prowess and heroism in the civil wars which prevailed here, and by dreadful and bloody affrays. In looking at this magnificent improvement of Lord Kames, in comparison with these memorials of revenge and hate, of misery and murder, (for aggressive war deserves no milder name,) I could not help feeling how infinitely higher is the honor of subduing the earth, that it may be rendered more fruitful, and serve the purposes of life and happiness, than any of the triumphs of military glory, any of the bloody conquests of revenge and unbridled ambition. These serve no other purpose than that of scattering abroad agony and desolation; glutting the most hateful passions of a depraved nature; and marking their progress, not by the displays of genius and skill, and the brilliant and rich fruits of civilization and humanity, but by laying waste the improvements and refinements of science and art, and pouring out every where a turbid flood of unmitigated wretchedness and death.

In England, Ireland, and Scotland, vast amounts of peat land have been subdued and redeemed, and, from being wholly waste and unproductive, are converted into well-tilled and fruitful fields. Thousands and tens of thousands of acres have been recovered in England; and, in Ireland, improvements of this nature are in progress on a most extensive scale. The single territory of Gleneaske, near Ballina, consisting almost wholly of peat bog, and which was to me the object of a most interesting visit, embraces about 3500 Irish acres, or upwards of 5600 English acres.* This, a public-spirited company, called the Waste Land Improvement Company, and possessing an ample capital, have undertaken to reclaim and cultivate, and have already made a considerable progress. There is, indeed, in Ireland, ample scope for this species of improvement, as the area of peat bog is estimated at no less than 2,833,000 acres, almost the whole of which is deemed capable of being redeemed, and brought into productive cultivation.

I know nothing in the United States resembling the bog land of Ireland and England. Much of it, indeed, is on a level surface, but extensive tracts of bog are elevated into hills of considerable height, composed wholly of peat, and that often, as I have seen, to the depth of six, and even ten feet on the summit.

Peat, properly so called, as my readers well know, is a deposit of vegetable matter, composed, in general, of a particular kind of plants, which have decayed under water, and containing much of the element which is called *tannin*, which preserves it in the state in which it is found, often impregnated with iron, or other mineral substances, and charged with acids unfriendly to vegetation. In its natural condition, it produces only a coarse kind of herbage, distasteful and innutritious, or is covered with a short moss; in Ireland, in many cases, by heath, alike worthless for any purpose of feed. It is retentive of water like a sponge, and is very difficult of being reduced, so as to furnish a good bed for a sweet and healthy vegetation. In a wet condition, it is scarcely accessible; in a dry state, it becomes too light and hard; and, though composed wholly of decayed vegetable matter, is in an inert condition, or deficient in some elements essential in order to render it productive. It is found of very different depths; in some cases, only a thin stratum of decayed vegetable matter, of six inches or a foot in depth, overlaying a bed of white sand or gravel; in others, a bed of black spongy matter, of many feet, and often of unascertained depth.

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* An Irish is to an English acre as 121 to 196.

Much of this land in England, Ireland, and Scotland, has been redeemed, and made highly productive. An eminent Scotch farmer, to whom I had the honor of letters of introduction, states that land which, in its natural state, was not worth more than sixpence an acre, in its improved condition is now fully equal to three pounds per acre. This refers to the annual rent or income of the land. This farmer has recovered two hundred acres of peat bog. Much of it was redeemed at a great expense, as it had been cut over for fuel, and it was deemed important to fill up the holes which had thus been left. Much of it was reclaimed at the expense of £30, or $150, per acre; but the farmer considered himself amply remunerated by the improvement. Other lands, which gave him not more than 1s. 6d., or 37½ cents, per acre, now give him 12s. to 14s., $3 to $3 50, per acre, annually. A similar improvement is stated by a farmer in West Somersetshire, whose peat land, before comparatively valueless, now lets for £3 to £4 per acre. The improvements in the fen land of Lincolnshire and Cambridgeshire, which is in many parts a species of peat land, have been followed by results equally valuable.

The extensive tracts of bog land in New Jersey, lying between the city of New York and Newark, in New Jersey, over which both the turnpike and the railroads now pass, open a field for improvements of the same kind and of the most valuable description. Partial attempts have been made already, and their success is sufficiently encouraging. But when the whole of this great extent shall be dyked against the tide, and the power of steam applied to its effectual drainage, the obtaining of a soil of the richest description, so near to some of the best markets in the country, will be likely to afford an ample compensation for any expense which may be incurred. It may be said that such improvements must be very distant in a country where immense tracts of unoccupied land, of the richest description, remain to be had at very low prices; but the proximity to a great city, and to several large and thickly inhabited towns, continually increasing, in population, business, and wealth, with almost unparalleled rapidity, must give a value to such lands which can scarcely be calculated, and keep far in advance of the competition of even the most fertile lands in a remote interior. Indeed, a slight inquiry will satisfy any one that the value of lands in the neighborhood of our cities, for agricultural and horticultural purposes, in spite of all the predictions founded on the improved and unlooked-for modes of conveyance by canals and railroads, has been continually rising, and has by no means reached the zenith.

Three difficulties may be said to present themselves in the redemption and improvement of all peat lands; the first is their wetness, and draining must be the first operation to be applied to them; the second is their want of compactness, for they are often too light and spongy for the growth of plants, though this defect will be partially remedied by the draining of them; and the third is the removal of some pernicious quality, some mineral acid, which is prejudicial to the growth of the best vegetation, or the supply of some element of vegetation which is requisite in the cultivation of any other plants than that of which the moss itself is formed. Peat, though wholly a vegetable substance, and, properly speaking, a compact mass of humus, — in itself furnishing, under a proper form of preparation, a useful manure, — is still deficient in the elements necessary for the growth of the finer grasses, the esculent vegetables, and the cereal grains.* What, in particular, these elements are, remains for agricultural chemistry to discover. The philosophers have approached the promised land, but have not yet got possession.

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* Professor Kane, in his instructive work on the Industrial Resources of Ireland, remarks, that " it is by the gradual formation and decomposition of this body (nitrogen) that the organic matter of the soil becomes so powerful an agent in its fertilization. The roots and fibres of a crop, left in the soil, gradually rot, and become thereby the means of absorbing from the atmosphere a quantity of nitro-

1. Drainage. — Drainage is the first step in the progress. The land should be pierced by deep ditches of at least four feet in width, and the depth, and distance from one to the other, to be determined by circumstances. Peat lands, or bogs, vary greatly in depth — from a foot to a depth, in some cases, of twenty feet, or indeed much more, and beyond being sounded, and which, in our improvements, it would be hopeless to attempt to reach. The only rule to be given is to make the drains of such a depth as to take off the water completely from the bog as low as three feet. It seems generally advised to leave the great, and, if so they may be called, the central drains open. If they are not sufficient to effect the perfect drainage of the land, then side drains, not sunk so deep, but emptying into the main drains, must be made. It is impossible to lay down rules, applicable to all places, for the distances at which these drains must be made from each other — so much must depend upon the extent of land to be drained; the quantity of water ordinarily to be removed, whether it be water from permanent springs or only flood-water from the hills; and, likewise, the descent or fall by which it can be carried off. Two eminent farmers in Lincolnshire, one of whom I had the pleasure of visiting, speak of making their ditches eleven yards apart, from centre to centre, and of four feet width; but no arbitrary rule can be adapted to all situations; and this must be left to the judgment of the improver. These ditches are left open; and perhaps, here, this is the only eligible mode; yet, on two farms in Massachusetts, where, I am proud to say, the improvements in redeeming peat bog, though on a comparatively very small scale, for the intelligence and success with which they have been made, would do honor to

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gen, which is rendered available for the sustenance of the next generation of plants. In estimating the fertility of a soil, therefore, it is most important to determine the quantity of these organic matters, and particularly the amount of nitrogen which they contain. The mere presence of organic matter indicates nothing; thus a peaty soil may be absolutely barren, if the decomposition of its organic matter has been carried on under water, where the oxygen and nitrogen of the air have not access, and consequently only inert ulmine, destitute of the power of evolving carbonic acid and ammonia, be produced." — p. 270.

any country, — the bog to be drained, in these cases, being a sort of basin surrounded by hills which were covered with stones, — a ditch of considerable width was dug, at the edges of the bog, to a depth of six feet, and filled in with stones of various sizes, gathered from the adjoining fields, to within about thirty inches of the surface, and then the bog earth returned upon the top, and the whole levelled. Thus a double purpose was answered — that of draining the bog, and clearing the neighboring land of unsightly and useless stones.

With respect to the position of the drains, some reference is to be had to the sources of the water by which the land is drenched. If it be flood-water from the hills, then it would be advisable, as far as practicable, to intercept it by cutting a ditch at the margin of the bog. If it arises from springs, whose source can be ascertained, then it would be desirable to reach these springs directly by a drain into which they might flow. If the springs are too numerous, and cannot be ascertained, then the best judgment must be exercised in laying out the main and the side drains. Here, the side drains emptying into the main drains are recommended to be made with tiles, and I have seen tiles of a very large bore, on the farm of one of the best farmers in Scotland, — and that is perhaps as high praise as I can bestow, — employed for the centre drains into which all the side drains entered, so that the whole work was completely covered in. The bore of these tiles was, I think, about eight inches by six, and considerable ingenuity was displayed in forming them by a method which I should find it difficult to describe so as to render myself intelligible. They were designed to be used with a sole, and holes were formed for the entrance of the side drains. They presented an example of extremely neat husbandry, and were effectual in relieving the land of a large amount of water. Where a solid substratum, whether of clay or gravel, is reached under the peat, tile may be used for drains without the soles, or the drains may be formed of broken stone, directly upon the hard bottom, as I shall presently describe; but where the depth of the peat is such that a hard bottom cannot be found, tiles without soles, or drains formed of broken stone, would soon become useless. In the Lincolnshire improvements, open ditches are made so as to include areas of twelve or fifteen acres; and these, without any under-drains, are found sufficient for the object intended. Open drains are made, likewise, on Chat-Moss, so as to include about an acre of land.

It is well known that open drains are liable to be constantly worn away by running water; and the overhanging surface breaks down by its own weight, and fills up the ditch. The severe frosts which occur in the northern United States, and which heave the ground deeply, and the sudden thaws which are consequent upon them, do much to disturb and break up the sides of open ditches. To guard against this as much as possible, it is advised to make the top of the open ditches very wide, and the slope of the sides very gradual. At Lord Ducie's model farm, under the care of that highly intelligent and practical farmer, Mr. John Morton, the slope to the drain (or the sides of the main ditch) receded so far, and was made at so small an angle of declination, that a cart might be driven upon it without danger of overturning. In most cases this could be done only at the expense of removing a large body of the peat. Whether this might not be advantageously pared and burned, and the ashes spread upon the land; or made into piles, and, by a proper intermixture with other matters, such as night-soil, stable manure, or lime, be reduced into a fine enriching manure; or carried into the stable or fold-yard to increase the compost heap; or, otherwise, be dried and employed as fuel, — must be left to the judgment of every individual farmer, according to the circumstances of the particular case. In such a mode of spreading and forming an open drain, which declines gradually to the centre, the very current of the water is a security against all injurious wear and tear of the sides; and it is obvious, if the land is devoted to grass, either in pasturage or mowing, it may be made productive to the water's edge. Upon the beauty of the appearance of such easy slopes, when made with the neatness and exactness with which all such operations are performed here, in Great Britain, I need not remark. The lines of all ditching and draining here are made with mathematical precision, and are in general as straight as they can be drawn. I am unwilling to say where I have seen such operations performed in a way to induce one to suppose that he who made them always walked backwards, and, after starting, gave himself little concern however zig-zag his course might be or at what point he should come out. Many of us, it would seem, have yet to learn that the most perfect mode of doing a thing is ultimately found to be the best mode, though, in the beginning, it may be neither the quickest nor the cheapest. There may be, in some cases, an extreme or excessive particularity or precision; and we are often told of people who are more nice than wise, though I have not found this class very numerous; but the exceptions may serve only to prove the value of the rule.

Farmers are not entirely agreed as to the degree to which the water, in draining, should be taken off. Some persons contend that the land should be rendered as dry as practicable, while others maintain that it is quite enough to reduce the level of the water to a depth of three feet below the surface, and that the land will be benefited by the presence of water at such a level, as it will serve to keep the soil moist — I suppose, by capillary attraction, and by evaporation. There seems to be some reason in this argument; and it is conformable to the opinion and practice of one of the best farmers whom I know. It perhaps admits of one qualification. If the water of the meadow is strongly impregnated with iron, or some mineral acid, as may in general be easily discovered from its rusty or colored appearance, its presence may be injurious to the roots of the growing plants. If it is clear or running water, it is obviously not liable to the same objection. By most farmers, however, it is recommended to make the ditches deep rather than numerous.

I shall return presently to the subject of drainage, and now proceed to speak of other processes customary in the improvement of peat land.

2. Paring and Burning. — The land being drained, the next process usually advised is to pare and burn the surface, and spread the ashes. This practice is not without its opponents. If the land is to be covered, as I saw in one case, with six or eight inches of mud or soil, the removal of the coarse vegetable matter from the surface would be an unnecessary, and perhaps some would think, a wasteful process; for, under such a mass of soil, its decomposition would be, though slowly, yet certainly effected. But where a sufficient covering is not intended to be applied to accomplish this purpose, the expediency of paring and burning the surface is, in my opinion, determined. There is always a large amount of the coarsest vegetation, which, if

turned up by the plough, would remain difficult of management, and very slow of decomposition, and much interfere with any crop which might be cultivated. But this being pared and burned on the ground, the ashes, which are stated to contain the element of potash, so useful in vegetation, furnish in themselves a valuable manure. In paring and burning, great care is to be used lest the burning should proceed too far, and burn deep holes in the peat, which would be both unsightly and inconvenient.

3. Application of Lime. — The next inquiry is, What application shall be made to the soil? Lime is very generally recommended, in places where it is accessible at a reasonable rate; but farmers are not unanimous as to its necessity or utility. The effects of lime are understood, in what must be considered the present imperfect state of the science, to be four-fold. It operates, first, as a mechanical divider of the soil; and this effect is undoubted and valuable. The application of sand to peat effects the same purpose. Secondly, the lime operates, by a chemical process, to decompose and reduce the peat; but on this point, chemists seem to hold a double doctrine — maintaining that, in some circumstances not very clearly defined, it dissolves and consumes, but, under other circumstances, it tends to harden and preserve, the woody fibre. This may be true in both respects, though we may find it as difficult to understand as the satyr, in the fable, did to understand how the traveller should blow in his hands to warm them, and blow in his broth to cool it. Lime is supposed to be beneficial in a third respect, that of furnishing to the plant a portion of food which it actually requires, an element of which its substance consists. This is not, of course, required in all plants which may be cultivated; nor to the same extent in plants of the same family. There is another advantage supposed to arise from the application of lime; and that is, its chemical effects in correcting the mineral acids which often abound in peat bogs. An excess of iron, which may be seen in the color of the stagnant water or drainings of these lands, is a common fault. The application of lime, in such a case, converts the sulphate of iron into the sulphate of lime, or gypsum, — that is, from poison into food, and wholesome nutriment, for vegetables. " Turf, or turfy soils," says Boussingault,

"yield rich crops when we succeed in converting the turf into humus. By a happy coincidence, turfy deposits frequently alternate with layers of sand, of gravel, of clay, and of vegetable earth, which have been accumulated at the same epoch. By a mixture, by a division, of these different materials, preceded in every case, however, by proper draining, mere peat bogs may be turned into good arable soil. Pyritic turf, however, shows itself more intractable; it rarely yields any thing of importance. To improve such a soil, it is absolutely necessary to have recourse to substances of an alkaline nature, such as chalk or lime, wood ashes, &c., which have the property of decomposing the sulphate of iron which is formed by the efflorescence of the pyrites." *

The experience of a distinguished farmer in Scotland, in the use of lime upon peat lands, is well worth quoting. He has improved two hundred acres of peat bog, which certainly gives him a right to speak. "The farmers in Scotland think that they cannot raise good crops of grain without lime, as the greatest part of the south of Scotland is composed of new red sandstone, grauwacke and granite, and therefore devoid of lime, which forms a considerable portion of every fertile soil; indeed, it was found that the soil in Dumfrieshire did not produce well-filled barley-crops until the farmers employed lime, which they now do to a great extent, and find it equally useful for potatoes and turnip crops, which is amply testified by the farmers' purchasing lime to the amount of £3000 annually from my lime-quarry at Close Farm." This value of lime to turnip and potato crops is a new fact. Certainly, I would hint not the slightest distrust upon the authority of this intelligent witness; but matters not half so weighty as £3000 worth of lime, purchased annually, at one's own quarry, may, without our own consciousness, somewhat affect the judgment.

This farmer adds, "I have employed lime, as it is practised in Derbyshire, to great advantage upon the surface of moor land, (i. e. bog;) but as it requires a very large dose of lime, it can only be done where lime is cheap, as it requires from 200 to 300 bushels of lime, per acre, to destroy the great quantity of vegetable matter in moor soils, which it soon accomplishes, as is

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* Page 304.

shown by the land being soon filled with moles, which are drawn to it by the decayed vegetable matter producing worms, the food of moles."

"In Craven, in Yorkshire, lime is employed very extensively, as a top-dressing, even upon a limestone soil. I have found that cattle feed upon pasture, well top-dressed with lime, much quicker, and that the meat is much richer and better mixed, than upon pastures equally productive of herbage."

4. **Rules in Ireland for Redemption of Bog.** — The directions given in Ireland for the reclamation of bog under very judicious and successful management, are as follows: —

"The first essential in reclaiming bog lands is, that they should be sufficiently drained.

"The second, that they should receive an ample covering of clay, soil, or gravel, not less than three or four inches deep.

The third, that they should be well limed, and that the lime should be applied immediately after being slacked, and mixed with clay; if lime cannot be had, ashes are a good substitute.* * * So soon as the ridges shall have had time to dry, forty barrels of fresh-powdered lime may be applied to the acre, and covered over with clay taken from the trenches."*

I believe that a dressing of lime for peat may always be safely recommended; but the expense would be, in many cases, enormous, and put its application quite out of question where a pecuniary return is expected.

5. **Application of Gravel or Sand.** — Other applications are made with success. Common coarse gravel is sometimes applied; but the only effect to be looked for, from such an application, seems to be merely the mechanical division of the soil, and the hardening of the surface. The late Earl Spencer,† a high authority in all agricultural matters, in the improvement of a tract of peaty meadow, which he had drained by means of a steam-

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* Principles for the Reclamation of Bog Land on the Cloghan Estate, by J. P. Kennedy, Esq.

† The unlooked-for death of this distinguished friend, and active and generous promoter, of agricultural improvement, has been deeply felt, and has left a sensible void in the agricultural community. To the memory of his personal kindness, his beautiful simplicity of manners, and his eminent, attractive, and amiable

engine, found that a thick top-dressing of sand improved the pasture more than lime, or any other dressing which he had tried.

6. Application of Clay, or Marl. — But one of the great improvers of peat land is clay, or marl. By marl, in this case, will be understood a substance composed of clay and lime, or a soft, unctuous earth, which indicates the presence of lime by its effervescing with acids. This, so far as my observation or knowledge goes, has been found invariably beneficial. A simple dressing of clay, to the depth of two inches, has given a desired compactness to the soil, and by degrees has, in the progress of cultivation, converted the dry, fibrous, and spongy matter into a rich black loam. This is represented to have been the effect upon the Lincolnshire fens, which have been repeatedly clayed or marled, though I saw small indications, although they are represented as peat, of that coarse, fibrous, light, and spongy character, which, by way of eminence, goes under that name, and which constitutes, it is said, nearly three million acres of the surface of Ireland.

In many cases of peat bog there is found, underlaying the peat or turf at varying distances, a substratum of clay or marl. By taking this out of pits, or out of the ditches which are dug for the purpose of draining the land, and spreading it on the surface to the depth of two or three inches, the best results follow. The soil is brought into a condition for cultivation. It is comminuted, or decomposed, and made fine; it is rendered compact; it retains that degree of moisture which is useful to vegetation, and furnishes a tenacious substratum for the roots of the growing plant. Its chemical effects may be considerable; but as yet these are rather conjectural than ascertained.*

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virtues, it will not be deemed misplaced that I here record the humble tribute of my grateful and most sincere respect.

"His saltem accumulem donis, et
Fungar inani munere.——— "

* It may be interesting to my readers to have the opinions of Mr. Anderson, of Scotland, on the Uses of Lime in Agriculture, whose essay on this subject was rewarded, by that distinguished body, the Highland and Agricultural Society, with a prize of ten sovereigns.

"Of the *leguminous* crops, we may say unhesitatingly, from what we have observed, that they cannot be cultivated with any success without the previous application of lime, unless where abundance of native calcareous matter exists in

The practice of one of the best farmers in Lincolnshire, whom I have the pleasure of knowing, is described by him as follows: —

He resumed the occupation of a farm which had been let to a tenant, and which had been all clayed over once. He fallowed it thoroughly, and, after getting some crops of cole or rape, he clayed it again, putting on about 300 cubic yards to the acre. Clay dikes are formed eleven yards from the centre of each, and are dug about three feet wide and four feet deep, which furnishes a large amount of clay to be applied to the land. He then went through a regular course of cropping, and clayed a third time, and obtained highly productive crops — forty bushels of wheat to the acre, and from sixty-four to seventy bushels of oats. He began to clay a fourth time, but not with the same success as before; from which he inferred that the land had been

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the soil." (Yet it seems to be a conceded fact that the application of lime is most beneficial where there is most lime in the soil. This is a remarkable, and, in a measure, an inexplicable circumstance. — H. C.) "The bean, indeed, and, so far as we have observed, the potato crop, are exceptions to this rule; although we have seen lime, in compost with earth or old turf dikes, give a most productive and valuable crop of potatoes."

"Whether spread on the surface of pasture-land alone, or in compost with earth, or applied with a crop and grass seeds, with a view to pasture, it never fails to call into existence the dormant seeds of the superior grasses in the soil, and to nourish and facilitate the growth of those that may have been confided to it by the agriculturist. This is a fact beyond all dispute. It is a never-failing fertilizer of grass land. The effects of lime on peaty soils are the following: —

"Peat is known to contain two substances inimical to vegetation, and eminently preventive of the changes and interchanges, the compositions and recompositions, necessary to afford a supply of genial nourishment to a superior class of vegetables. These injurious substances are tannin and gallic acid. But let us consider for a moment the composition of these inimical compounds, and we shall find that we have it in our power, by a simple process, to convert them into substances most friendly to the advancement of superior vegetation, and in this form contributing highly to the fertility of soils. We find, on analysis, that they are composed of the following constituent proportions: —

	Carbon.	*Hydrogen.*	*Oxygen.*
"Tannin, ...	52.59	3.825	43.583
Gallic Acid, . . .	56.64	5.00	38.35

"We have shown that quicklime and hydrate have a powerful affinity for carbonaceous matter and oxygen. This known, with the assistance of the above analysis, it is at once clear how they operate beneficially on peaty soils. It is evident that, by appropriating a portion of the carbon and oxygen, lime neutralizes the acid in both these substances, itself becoming a carbonate; and, by this change, substances that were formerly destructive to fertility, combining in sufficiently dosed. Indeed, in such cultivation it can scarcely be called the culture of the peat, but the actual bringing up of a new soil, wholly different from the peat, and the cultivation of that. It would be a great error to suppose that the land in this case was not manured. Two or three of the crops of cole or rape grown upon the land were eaten off by sheep, folded on the land; and other dressings of manure were liberally applied. Other examples of the advantages of claying peat might be referred to as equally decisive. But I shall quote the account given by Mr. Morton, to whom I have already referred, and the proofs of whose skill, and science, and success, I have witnessed with the highest pleasure, on that which deserves to be called a pattern farm.

"The fens of Lincolnshire," he says, "have been increased in

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part with the lime, are resolved into their simple elements, and, assuming a new character, gradually become capable of sustaining an improved vegetation. Of course, as we have already shown, the lime will act on the fibrous vegetable remains in the soil, combine with them, and convert them by degrees into soluble and fructifying nutriment for vegetables. If, after peaty lands have been once limed, it should be found advisable, for any cause, to break up a lea, (and this should be as seldom as possible, such lands being better laid to grass,) it would be an improvement to do so by paring and burning, as, by the application of heat, a portion of the lime now converted into carbonate, from being so long buried and in close contact with the soil, would be freed from its acquired acid, and restored anew to its original purity when first applied — or, in other words, be reconverted into quicklime, and would thus be rendered capable of exerting a renewed action on the peaty substances present, and, from its recovered causticity, again promote the various processes of decomposition and recomposition, so favorable to the development of healthful and luxuriant vegetation." — *Journal of the Highland and Agricultural Society, for October*, 1843.

"The decay of woody fibre," says Liebig, "is very much accelerated by contact with alkalies or alkaline earths; for these enable substances to absorb oxygen which do not possess this power themselves. Alcohol, gallic acid, tannin, the vegetable coloring matters, and several other substances, are thus affected by them. Acids produce quite an opposite effect; they greatly retard decay." — Page 361, *Boston edition*.

I give these quotations for the benefit of my readers. They are among the best scientific explanations, which we have had, of the effect of lime upon peat. It would be quite presumptuous in me to say that I endorse or deny them. Some of my readers will think that the explanations need explaining; and I am not without some sympathy in their difficulties. Most of us get on as far as the Oriental philosophy, that the earth rests upon the back of an elephant, and the elephant stands upon the back of a tortoise. But what does the tortoise rest upon? Here we are obliged to stop; and here, too, science, in all its pride, is often compelled to stop with us.

productiveness, at least 100 per cent., by applying to the surface of the peat the clay which is found at depths varying from two to five feet below it. The application is made thus: Trenches parallel to one another are made eleven yards apart, and three feet wide down to the clay; and then two feet in depth of the clay is thrown out, one half on each side. The effect of this, after the second year, is greatly to increase the productiveness of the soil; in many cases, to double it." *

7. Application of Mud or Loam.—There is another application to the improvement of peat soils, of mud or loam, which is, of course, beneficial. An example of this kind, which I visited at Hatfield Chase, in Yorkshire, is so remarkable for the boldness of the enterprise, that I must not fail to notice it. Mr. Gossip, having purchased 4000 acres of peat bog, in its natural condition comparatively worthless, has undertaken the reclaiming of it. In the neighborhood was the deserted bed of a river, which had been laid dry by the making of a canal, into which the waters had been turned; and a deep body of silt, or rich mud, deposited in the river, was now rendered accessible. By constructing a temporary railroad, on which a steam-engine was at work, he was drawing out in carts this mud, and spreading it eight inches thick over the bog. The carts were drawn up an inclined plane by means of the steam-power, and were then carried along to the place of deposit, and their contents spread so as to cover the ground to the depth of eight inches. The rails on which the engine and its train of carts moved were formed by two pieces of heavy timber, on which an iron bar, forming the rail, was laid; and, by a machine or crane, suspended from a frame or triangle, these timbers were taken up as occasion required, and, being suspended, were swung round and placed in the desired direction for the carts to proceed upon. The cost of covering the land in this way was stated to be £14, or $70, per acre; but, when accomplished, an ample remuneration seemed sure. It was, indeed, a gigantic enterprise; and the spirited improver had bravely overcome many immense difficulties and dis-

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* This is an extract from a letter of Mr. Morton to Philip Pusey, Esq., M. P., given in Mr. Pusey's admirable Essay on the Improvement of Peaty Ground.—*Journal of Royal Agricultural Society*, vol. ii, part 3.

couragements in the undertaking. This was, however, in truth, the creation of so much land for cultivation, of which the bog might be said to form merely the floor, or substratum. In the cultivation of the land, portions of the bog would be brought up and mixed with the soil which had been laid upon it, and both would be improved. Such enterprises as these, undertaken by an individual, indicate the great amount of capital which exists in this country, ready to be applied when it may be advantageously brought out.

There was another operation, in the way of improving bog or meadow, by the application of loam or clay, which I saw on my way to examine the one described. It was on a small scale, indeed, compared with that, yet, for the mode in which the earth or clay was conveyed on to the bog, was quite deserving of notice. The earth or clay to be applied was dug from a bank or side-hill, on the margin of the bog. Cars or carts were made, about four and a half or five feet long by about three feet in width; and these were so contrived as to run upon two wheels, placed very near to each other under the centre of the carriage, and so fitted as to preserve the balance of the cart. In this way they were made to run easily upon a single rail, formed, by a flat bar of iron, or two bars placed very near each other, upon a thick plank, a foot or fifteen inches in width. This, it is obvious, was easily removed by hand from place to place, and, once being laid flat, required no further adjustment; whereas a railroad of two separate rails, on separate pieces of timber, requires a good deal of arrangement in order to bring the two rails even. In the case of which I am now speaking, the carts were guided by hand; and, upon being emptied, were shoved back again by hand, in order to be filled. The softest bog, which had any consistency, could be easily reached in this way, and the simplicity and inexpensiveness of the operation seemed quite worthy of remark, because within the reach of persons of very limited means.*

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* I find, since writing the above, that a similar process was adopted, in reclaiming Chat-Moss, by the distinguished Mr. Roscoe, in 1797.

"Mr. Roscoe gave it as his decided opinion, that the best method of improving moss-land is that of the application of a calcareous substance, in sufficient quantity to convert the moss into a soil, and by the occasional use of animal, or other extraneous manures, such as the course of cultivation, and the nature of the crops, Sand is stated to have been applied to a drained bog in Scotland, at the rate of a single-horse cart-load to every square yard of surface; but the land was so soft that, in order to prevent sinking, the horses had wooden clogs or pattens on their feet — that is, a wooden shoe much broader than the foot. The simple method, above described, of using a single railway easily transferable, would obviate all the difficulty mentioned.

8. IMPROVEMENT OF CHAT-MOSS. — I shall insert here the answers which I received from a very extensive improver of bog land on Chat-Moss, to questions which I proposed to him, acknowledging, at the same time, my obligations to his kindness.

(1.) The condition of the bog or moss? — It was originally a sterile, wet soil, wholly unproductive.

(2.) How drained? — By close drains, four and a half yards from each other, using no other material but the sods to make the close drains, which are from thirty to thirty-six inches deep. The fields are one hundred and fifty yards wide, by three hundred yards in length, divided by open drains four feet deep, into which the close drains discharge themselves.

(3.) What applications are made? — After the drainage is complete, it has been usual to lead, upon each acre of land, one hundred and twenty tons of marl, from the margin of the moss; and afterwards to spread forty tons of Manchester night soil.* The ground is then fit for cropping.

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may be found to require. The cost of marling was stated by Mr. Roscoe at £10 per acre, at which cheap rate it would not have been possible to have performed the work, but for the assistance of an iron railway, laid upon boards or sleepers, and movable at pleasure. Along such a road the marl was conveyed in wagons with small iron wheels. Each wagon, carrying about 15 hundred weight, was drawn by a man; and this quantity was as much as, without the employment of the railway, could have been conveyed over the moss by a cart with a driver and two horses."

This, to some of my readers, may seem an early use of the iron railways. Some form of them was adopted ten years before this, at some of the coal quarries.

* It may be interesting to my agricultural readers to know something of the amount of this manure collected in Manchester. My other readers, being forewarned, are of course forearmed.

The night soil of Manchester is taken into the country by carts, and must be removed before 9 o'clock in summer, and 10 o'clock in winter. (In Boston, U. S. A., they order these things better. The night carts are not suffered to

Instead of the marl and night soil, Mr. Bell (the tenant) has tried four tons of lime, five hundred weight of salt, and ten hundred weight of guano; and this he thinks, from his experience, answers equally well, at less than half the cost.

(4.) What crops are grown? — Wheat, oats, potatoes, turnips, and hay.

(5.) What is the amount of produce per acre? — About the same quantity as from land of the ordinary kind of average quality.

(6.) What is the condition of the land afterwards? — Much the same as of other land after cropping.

(7.) In what state are the manures applied? — In the state in

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enter the town before 10 o'clock in the evening, and must be beyond the limits of the town before 5 o'clock in the morning.) Sometimes it is carried in boats, on the Mersey and Irlwell, and on the Bridgewater and other canals. It is mixed generally with coal ashes, and is sold at about 1 s. 6 d. per ton, and applied to the growth of potatoes and other vegetables.

It is ascertained that more than one thousand tons of this manure passed by the Cheshire road, alone, weekly, to be used for the growth of potatoes. It is deemed excellent as a preparative for the succeeding crops of wheat and clover.

From the 16th to the 22d of August, inclusive, 1843, there passed through the Cornbrook bars 647 loads, averaging two tons each, making 1294 tons. The amount of stable dung which passed through the same bars, in the same time, was 113 loads, averaging two tons to a load, making 226 tons.

During that time the farmers were busily engaged in harvest, and of course few of them could leave home. When the dung carts were last counted in the spring, they were found to be double the number here stated; and the annual return of potatoes from this source may be safely taken at 300,000 loads.

The amount sent by the Cornbrook bars is supposed equal to all that goes by other roads and conveyances out of Manchester.

Value and Use of Night Soil. — One ton of night soil, mixed, as it generally is, with coal ashes, is considered sufficient for manuring three Cheshire rods, of 64 yards each, or 192 square yards, for the usual course of crops, followed by the best farmers, on land of ordinary quality; viz., potatoes, wheat or oats, clover and other artificial grasses.

Thus one ton of manure will, on an average, produce, on 192 yards of land, nine bushels of marketable potatoes, of 80 pounds each, which will be one Manchester load of three bushels, or 240 pounds, on every rod of ground; so that 1000 tons of night soil, passing the Cornbrook bars, may be expected to send back to market 156,000 loads, or 468,000 bushels of potatoes, annually.

These facts and calculations, with which my valued friend, Dr. Playfair, has furnished me, are curious and striking; and, if they do not fill a man with profound and grateful adoration for what Mather calls the wonder-workings of the Divine Providence, there can be little difficulty in determining, whatever may be his pretensions, in what class of animals such a being should be ranked.

which they come out of the marl pit, and out of the middens, the marl being pulverized and spread pretty equally on the surface of the land, after it has fallen to pieces by influence of the frost and the sun.

(8.) How many years or seasons since the application was first made? — The estate has been in my hands twenty-five years, and during that time it has been progressively improving. The marl requires to be renewed about every ten or twelve years; and the other manures as upon other land.

9. Depth of Ploughing on Peat Soils. — On the depth of ploughing or cultivation, to be adopted in respect to peat soils, a diversity of opinion prevails among the English farmers. Where the depth of peat is small, and this overlaying a hungry, cold, white gravel, to bring this matter to the surface, and bury the vegetable matter beneath it, is to pronounce a sentence of long and almost hopeless barrenness upon it. Where the peat is deep, and the top is pared and burned, many farmers are satisfied with simply harrowing or scarifying it, and sowing the first crop. Where the land has been pared and burned, and a dressing of clay or marl applied, it will be safe to go deeper with the cultivation. Here, however, the course to be pursued must be regulated by circumstances. If the crop to be grown is a grain or grass crop, it is not necessary to cultivate as deeply as in the case of a potato or turnip crop, or of any tap-rooted vegetable. The great danger to be apprehended, in the cultivation of peat, is, that it will lie too high and open, and not be sufficiently compact. Mere rolling will not bring it to a proper consistency, and consequently it is, after being sowed, often trodden by men and women. This method is not likely to be adopted in the United States. If the land is to be sowed with grain, or laid down to permanent grass, either for mowing or pasturage, and has been well dressed and manured, it is advisable to plough only so deeply as thoroughly to intermix the matter so applied with the peat. The roots of the plant sown in such case, extending themselves into the peat, will dissolve and reduce it; and when it comes, after a while, to be cultivated for other crops, it will be found in a fine and reduced state. This fact has been strikingly verified within my own observation. In a case where a deep salt marsh, a bed of almost pure fibrous mat-

ter, had been enclosed and embanked from the sea or tide, and was then, having received a dressing of loam of two inches thickness, from a neighboring bank, sown with a mixture of grass seed, and afterwards constantly depastured by stock, it was found, after a lapse of several years, to be completely decomposed; and the spade which I thrust into it brought up what appeared to be nothing else than a bed of rich vegetable mould, without any appearance of fibrous matter, other than the roots of the grass on the surface. It is found, here, that the tendency of clay or marl is to sink down into the peat, and therefore the dressing requires to be occasionally renewed. They recommend to apply the quantity, which may be deemed ultimately sufficient for the reclamation of the bog, in successive small quantities, rather than at once. Sand and gravel, from their greater specific gravity, will, of course, have a greater tendency to bury themselves than any other applications.

10. Manures for Peat. — Of the manures applied to the improvement of peat land, night soil is deemed to stand at the head. This is not usually applied alone, but mixed, as above stated, with coal-ashes, or otherwise compounded with loam or with peat itself. In the latter case, it is advised that the peat should be dry, and then reduced to a fine state, so as to absorb the liquid portions of the night soil. By whatever means heat can be produced in a heap of peat, whether by the interleaving of layers of fresh horse-dung, or otherwise, the peat will be reduced to a fine condition for composting. The subject of forming peat compost will more properly come under the head of manures. Bone-dust is stated to have been applied with advantage to peat lands, but I am not in possession of any detailed facts or trials on the subject. Mr. Cooke, an intelligent farmer, recommends this application; and Mr. Pusey, M. P., an agricultural authority entitled to the highest confidence, has tried it with success. The application referred to above, of four tons of lime, five hundred weight of salt, and ten hundred weight of guano, is quite worthy of notice. The use or advantage of the salt I am unable to explain. This subject has been greatly controverted, and seems still left in doubt. Sir Humphry Davy inculcates that a certain amount of salt tends to promote decomposition; but, beyond that, its effects are directly the reverse, being preservative,

and preventive of decay. The limit, however, is not defined. Others think that the advantage of salt is to be found in its absorption of moisture from the air. This seems a highly probable advantage in the case referred to, as peat lands, when thoroughly drained, are liable to suffer from drought; and the good effects of guano are supposed to be considerably affected by the presence of moisture. Salt is certainly conducive to the destruction of insects. In a manuscript lecture of Dr. Playfair, with the perusal of which he has kindly obliged me, in speaking of common salt as a fertilizer, he says, "Liebig ascribes its action to a decomposition of the sulphate of lime in soils, by which sulphate of soda enters into the plant. Without hazarding an opinion as to the truth of this view, I would simply remark that, if this be so, salt should act most beneficially on the cereals and on the leguminous plants, because they are the great generators of the constituents of blood, gluten, albumen, and casein; and these are the parts of plants for which sulphur is absolutely necessary." These conjectures, to whatever credit they may be entitled for their ingenuity, seem little else than floundering in the dark. The day may presently dawn upon us. It is clearly advisable and wise to draw the curtain back and let in what little light may come. This little word "if" is certainly one of the most convenient words in the language, and performs, in science, a similar office to "charity" in morals — that of covering a multitude of errors.

The example given above, of the application of guano to peat, and its salutary effects, is the only one which has come to my knowledge. This extraordinary manure seems destined to produce the most beneficial effects upon agriculture. What a pity it is that we cannot induce these useful birds to make their home among us, and save us the trouble and danger of a voyage round Cape Horn! But they know our savage propensities too well; and, if the doctrine of transmigration be true, they may have heard the story of the avaricious *gourmand*, who killed the goose that laid the golden egg.

11. **Cropping of Peat Lands.** — The course of cropping of peat lands, in this country, is somewhat variable. In the fens of Lincolnshire, which, though peaty, can hardly be treated as bog, an eminent farmer states that, the land being brought into

condition, the first crop sown is rape or cole, a plant very much resembling mustard. This is twice fed off, in the season, by sheep which are folded upon it. To my American readers let me say that by folding, in this case, is meant that a certain portion of the field is enclosed by a light fence, — it may be of hurdles or of twine net-work, (which is somewhat dangerous, from the sheep getting their heads into the meshes and becoming strangled, or tearing the fence down,) or of light rails, which are movable from one part of the field to the other, — so that, when one part of the crop is consumed, another portion of the field is enclosed, into which they are driven, until the whole field is gone over. This gives it a thorough dressing, especially as the sheep, in such cases, generally receive some grain with their feed. After this the field is clayed again, and then sowed with oats; second year, wheat; third, cole with manure; fourth, oats; fifth, wheat; sixth, cole or turnips, well manured; and then clayed again. In the same time, the farmer, of whose cultivation I am speaking, consumed six or eight tons of oil-cake, with about twelve acres of meadow-land hay, to assist in converting his straw into manure; all which was divided, upon his cultivated land, on a farm consisting of 100 acres. With this very thorough cultivation, he obtained forty bushels of wheat to the acre, and about seventy bushels of oats. In other cases, the course of crops has been — first, turnips; second, oats; third, wheat; fourth, seeds mown or grazed, — that is, the land laid down to grass; fifth, wheat again.

How far such a course of crops could be advantageously introduced upon the peat lands of the United States, I am not prepared to say. The culture of rape, within my observation, is unknown; but the practice of consuming a crop upon the land, by folding sheep upon it, is an admirable foundation for good husbandry, and will be, I hope, one of the earliest improvements that we shall adopt.*

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* A curious circumstance is mentioned in a letter from Mr. Wingate to Mr. Pusey, in his thorough essay upon the Improvement of Peaty Ground, to which I acknowledge myself much indebted, which I shall quote: —

"In Lincolnshire they never sow rape so early as May, but chiefly in the middle and latter end of June, and stock it as soon as the weather becomes sufficiently cool, so that it will not injure the lambs, which in warm weather are subject to have the blood-vessels of the ear much enlarged, and often lose a part

In Ireland, the first crop usually taken from peat lands is potatoes; and these are generally grown in the lazy-bed method, to which I have referred in a former report. In this case, where the peat rests upon clay or a hard subsoil, the ground is first laid out in beds varying from four to six feet in width, and divided lengthwise by trenches which empty into an open drain; dirt, or bog earth from these trenches, being, as it is dug out, laid upon these beds. The seed potatoes and manure are then placed upon them, and covered with another digging of earth, or clay from the trench. When the potatoes, which are planted crosswise of the bed, in rows about a foot apart, have shown themselves above-ground a few inches, they are then covered with a second digging of earth, or soil from the trenches. This completes the cultivation. The land is the next year sown with oats, and sometimes laid down to grass; or, in some cases, a crop of wheat is taken. Sometimes the old trenches are filled up, and a new laying out of the ground, and a new trenching, is made, and the process, as at first, repeated. Where the means of improvement are so limited as in Ireland, and the social disadvantages so great, Irish husbandry can be in but few cases referred to as a model. This remark, however, must not be received, as I shall presently show, without strong exceptions in some parts of that country.

I have gone thus fully into the subject of the improvement of peat lands, because, in parts of New England and New Jersey, and other parts of the country, there are vast bodies of this kind of ground, waiting the resuscitating hand of intelligent cultivation. I know of many distinguished examples of the most judicious and successful improvement in my own country, to which I have not deemed proper, in this place, to refer. The strong conclusions to which I have come in the case are, first, as the indispensable basis of the improvement of such soils, they must be well drained; secondly, that, in most cases, paring and burning, and spreading the ashes, are advisable; in the third place, that, although lime may be useful, a dressing of clay of

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of the ear, if not taken off the rape for a few days, which generally sets them right again. It is generally consumed in the months of October, November, and December, before it is injured by severe frost."

This is literally a *rape* of the ear, and is probably owing to some acrid matter belonging to the plant, which in its general character resembles mustard.

moderate thickness would be still more useful; in the fourth place, that the depth of ploughing should be seldom greater than thoroughly to mix the dressing applied with the soil, but not to bury it; fifthly, that there is little danger of being too liberal in manure, and the stronger and the more active the manure, so much the better; and, lastly, that, whatever crop is grown, the most advisable course is, as soon as possible, to bring the lands into permanent mowing or pasturage. Some of the largest crops of timothy or herdsgrass, which I have ever seen, have grown upon such lands; and, where well reclaimed and managed, few lands will carry a heavier amount of stock.

In speaking of the crops which may be cultivated on these lands, I should have added that barley is generally discouraged, the grain produced being represented as inferior in quality. I have no authentic facts in the case; and this, after all, may be mere prejudice.

XCIV. — WARPING.

In giving an account of the agriculture of England, it would be wrong for me to omit the practice of warping land — an operation which has taken place in Lincolnshire, and on the borders of Yorkshire, in the neighborhood of the Humber, a considerable river, which, at its mouth, opens into a large estuary, or arm of the sea. It consists in introducing the tidal waters of this river upon lands lying lower than the tides at their flood, and there detaining them until they have deposited a considerable portion of the fine matter, or silt, commonly called *warp*, which they hold in suspension. In this way, by degrees, a deposit of one, two, three, and sometimes more feet is made, which forms one of the richest soils that can be found, easily tilled, requiring at first little or no aid from manure, and producing the richest crops and the most abundant pasturage. I went over these grounds with singular pleasure, admiring the skill and energy which could boldly triumph over many obstacles, and wrest from the dominion of the sea a vast body of soil, before this utterly profitless, but now converted into rich fields, loaded with an exuberant vegetation. Three thousand six hundred acres have already been recovered, with a prospect of a considerable accession. These are certainly among the most beautiful triumphs of human art, and compel one to reverence that intellectual power which lies at the basis of such improvements.

The River Humber, formed by the contributions of the Ouse and Trent, and several smaller rivers, opens into a large bay at its mouth. At its junction with the sea, its waters are said to be quite clear; but within they are quite turbid, and a large quantity of fine silt, siliceous and aluminous matter, is held in suspension by them. Extensive tracts of low bog, and other lands, lie above on the river or rivers emptying into the Humber; and the object has been to introduce this muddy water upon these lands, and there keep it long enough to give time for it to deposit a considerable portion of this floating substance.

In order to approach these lands, a deep canal, in one case, was cut, at first for a distance of three miles, and since that time extended to six miles. The dimensions of the canal were 30 feet wide at bottom, 90 feet wide at top, and 11½ feet deep; and a sluice-way built of stone, with two openings of 16 feet each, and four strong opening doors, was made at the entrance of this canal, to admit and control the tides. Most substantial banks were made on the edges of this main drain, and it answers the purpose of a canal for the admission of vessels of 70 and 80 tons burden, which ascend it for the purpose of bringing down the produce of the country to be conveyed to market. The lands now intended to be flooded are banked in by strong embankments, and a sluice-way is cut to the main drain, so that, when the water is admitted to the main drain, it may flow into these enclosed spaces. Here it remains in a stagnant state for a time, and at ebb tide is let off again, preparatory to the reintroduction, at another tide, of a fresh supply. When the deposit has become sufficient, the sluice-way is filled up, and the embankment rendered complete and efficient against the irruption of the tide, and the land placed under a course of cultivation. A good deal of ingenuity is required, in order to give the water a proper direction, and enclosures are made within other enclosures; and great care is requisite to prevent a too sudden irruption of the water, and to avoid opposing currents meeting each other, which is apt to occasion irregularities of surface and sand-banks; and skill is required so to conduct the water, that the most abundant deposits should be made in the lowest place, in order to bring the bottom to a uniform level. The work requires to be done substantially, and the banks made very strong, lest they should leak, or be burst through by the violence of the water.

A well-informed man, familiar with the process, gives the following account of it: "The water conducted by the main drain into the embanked allotment is more or less divided into smaller ones, called 'inlets,' (which vary much in size,) and conducted to different parts of the compartment; for, wherever the current, leaving a drain, expands itself, there the greatest quantity of warp is deposited. As soon, then, as the plots of land next the mouth of the inlets have a sufficient quantity of warp deposited, the inlets are extended by what are called 'call banks,' which, though much smaller than the others, still conduct the current onwards to parts not acted upon by the currents before, and so on, as required. One of the greatest niceties in warping is to have the land finished as level as possible, which can only be done by the strictest attention, and by proper judgment in conducting the different currents, which must not be suffered to cross one another, or to meet, as, in such a case, the deposit of the warp is less, not so regular, and of an inferior quality."

"Care must also be taken that the currents should not be too strong, for in warp there is a considerable portion of sand, which, being the most heavy of all the particles floating in the water, sinks first, the lighter particles being carried on by the violence of the current; consequently, a sand-bed is formed. These sand-beds, however, if covered afterwards with warp, generally are found to crop better than warp, which may be too strong.

"With respect to the depth of warp deposited, it depends much upon the level of the land to be warped; for, should the land be very irregular, in some places there would be a great deposit, and in others only, comparatively, a small one. It is generally advantageous to have the land to be warped as level as possible. A deposit may then be obtained, of from one to three feet, and in some favorable situations it has been considerably more; but it cannot be generally calculated on." *

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* R. Creyke's Account of Warping.—*Journal of Agricultural Society*, vol. v. part 2, p. 402.

The amount of mud thus deposited in a single season was, as I was informed, as much as eighteen inches. Mr. Creyke says, "that in one spring, during ten or twelve tides, he has known 10 or 15 acres to have been warped the thickness of from one to three feet; and that in June, 1829, a compartment was commenced of 160 acres, which was finished in January, 1830, a period of only seven months. During that period, a general deposit took place of between one and three feet; but that was an extraordinary season, and the compartment lay in a favorable situation for being warped."

The value of such land is very great. Bog lands, that were worth only 1s. 6d., annual rent, became worth 50s., per acre. The crops obtained on such land are very large, and it is considered as too rich for wheat, until it has been severely exhausted by other crops, such as potatoes, flax, rape-seed, and clover. It has been known to yield ninety bushels of beans per acre, and from three hundred to nearly six hundred bushels of potatoes; and three tons of clover at a first cutting, with a good second crop, and abundant pasturage afterwards.

This is another specimen of what may justly be called the creation of a soil; for, where there is a rich deposit of three feet depth of alluvion, it is of little importance whether the substratum on which it rests be sand, or bog, or stone. The turbidness of these waters, and the quantity of earthy matter held in suspension, are remarkable circumstances. It has been the subject of much curiosity whence it could arise. It has been said that it comes from the abrasion of a long extent of sea-coast by the waves; but this would hardly account for it, for the water is said to be clear at the junction of the river with the sea. By others it is said to be the washings of the cultivated soils in the interior, brought down by the several rivers and streams which pour into the Humber; and the fact that the warp is most productive of weeds, and of white clover, establishes the fact of its obligation to these sources. The mouth of the Humber has, without doubt, for years and centuries, been the great receptacle of the washings of the upper countries; and there they collect, and remain in a state of constant excitement and suspension, — at least the upper portions, — from the waves, and currents, and tides. This is undoubtedly the source of this vast body of silt, which is floated backwards and forwards by the flux and the reflux of the tides. In some cases the deposit is made at successive periods; as, where the productiveness of a field has begun to flag, the tide is readmitted, and a new dressing of mud is given, to recruit its energies. This can only be done until the surface has reached the height of the highest spring tides.

It has been objected "that there is a species of rich loam, which, under the name of alluvial soil, is understood to mean land which has been gained, in low situations, by the overflowing of streams from higher grounds, or, by the artificial process of warping, from the turbid waters of muddy rivers, as well as by slimy matter thrown up by the tides, and afterwards embanked; that this contains a large proportion of vegetable and animal matter, which gives it a dark color, and produces almost inexhaustible fertility: but the quality of its products, though luxuriant to the eye, is not equal in nutriment to those grown on drier land." This may be so; but it is an objection which I did not hear stated among the cultivators of these lands; nor have I ever heard it from the cultivators of those beautiful lands, in the United States, which lie upon some of our fine rivers, and are flooded and enriched by the deposits from their annual overflowings.

The substance called *warp* has been found, upon analysis, to contain mucilage, with a minute portion of saline matter; a considerable quantity of calcareous and aluminous earths; and the residue, mica and sand — the latter in by far the larger quantity, and both in very fine particles. That is to say, it is, and is likely to contain, a mixture of whatever has been brought down, by the rains and rivers, from the cultivated country of the interior.

The Delta of the Nile, and its rich banks and meadows, annually overflowed, are composed, without doubt, of the same materials, and their extraordinary fruitfulness is proverbial. On the Mississippi, at the junction of the Ohio with this mighty father of waters, there is an immense tract of land, annually overflown, of the same rich description; and when, as it may happen in the progress of time, those now vast solitudes shall be teeming with population, these great spaces of rich alluvion — when the overflowings of the river, by embankment, shall be excluded, or occasionally admitted, at pleasure — will exhibit an unsurpassed productiveness.

On the smaller rivers, — the Connecticut, for example, — whenever, in its occasional inundations, any portion of its waters is arrested and held stagnant, a marked increase of productiveness is sure to follow. The very superior richness of the meadows on the Deerfield River, a small tributary of the Connecticut, is doubtless attributable to the fact that, when the Connecticut is at its height of flood, the waters of the Deerfield are driven back and held for a time stationary, when they copiously deposit the enriching matters which they have gathered from the higher lands, and hold in suspension. The great river, in its swift passage over the lands, leaves little behind it; but it has occurred to me that, when capital has become more abundant, and the spirit of improvement more bold and active, there may be many situations on the river where, at not an exorbitant expense of embankment, advantage may be taken of the flood to arrest some portion of the waters, and hold them fast until they have dropped their wealth upon the land. In most cases, probably, the great hinderance to such improvements would be the vast masses of ice which come down in the spring floods, defying almost every barrier, and sweeping every thing before them in their progress.

Many of the rivers in England, which I have visited, are extremely discolored and turbid. The amount of cultivated land may be a principal cause of it. All the rivers which enter into the Humber, — for I have crossed them all, — the Avon, near Bristol, the Severn, at Gloucester, the Usk, near Newport, Monmouthshire, are all copiously charged with mud in suspension. The Ex, in Devonshire, the Mersey, and the Clyde, are very much of the same character. The Thames is a floating mass of impurity and filth. In order, upon the present system of warping, to effect an improvement, it is necessary that the land to be warped should be lower than the tide by which it is to be covered. But it does not appear to me irrational, or premature, to look forward to the time when this difficulty shall be obviated. As I shall presently show, two immense steam-engines, one of sixty, and one of eighty horse power, which I had the pleasure of seeing, and of admiring their mode of operation, clear thousands of acres of land (at a moderate expense, compared with the good achieved) of the drainage water. Why, by the same mighty power, which is fast effecting immense changes in all the departments of labor, may not this mass of turbid water be thrown upon lands higher than the highest tides, and there held fast until it lets go the riches which it holds; and thus, in all accessible places, this improvement be successfully carried on? It must be long before we may look for such great enterprises in the United States; yet the extraordinary value of land here, and the immense amount of capital seeking a profitable investment, warrant almost any expenditure; and the permanent utility and beauty of such improvements — I had almost said, their moral sublimity — ought to stimulate ingenuity, labor, and skill, in every quarter. If he is to be pronounced a public benefactor who makes two blades of grass grow where but one grew before, what shall be said of him who, by the boldness of his enterprise, stays the proud waves of the ocean; arrests the impetuous current laden with plunder, and compels it to disgorge; and rescues thousands of acres, over which the waters of the sea spread only waste and desolation, and compels them to glitter with golden grain, — instead of the hoarse voice of the beating sea, to resound with the glad notes of harvest-home, — and the extensive plains to swarm with an industrious population, and the fields to be crowded with bleating and rejoicing herds!

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XCV. — AN EXPERIMENT.

I ought not to pass over an experiment I witnessed, in Eastbourne, Sussex, of making a productive field on a bed of shingle. By "shingle," it may be necessary to explain, for some of my readers, that I mean the heaps of small and worn round and flat stones, which are thrown up by the sea, and constitute often the upper portion of a sea-beach. A considerable piece of such land was enclosed by a stone wall, and mud and clay, to the depth of more than a foot, evenly spread over it. It was then, after being properly manured, sown with wheat, and produced a good crop, and, when I saw it, was covered with a good yield of grass. The material being near, the expense, though considerable, was not over-large, and an ample remuneration was obtained. It did not appear to suffer from drought, as one would have supposed; though, ordinarily, few things suffer from drought in England; and it was done by a benevolent individual, the late Mrs. Davies Gilbert, who was full of works of active good, by way of showing that even the most barren spots might, by labor, be made productive; that this might be done, in many situations the most unpromising, with a full return for the labor and expenditure; and that, in many cases, all that is necessary, to enable the poor to provide for their own necessities, is to give them the opportunity of exerting their own powers.

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XCVI. — STRAIGHTENING A RIVER.

On the eastern shores of England, near where the boundaries of Lincolnshire, Cambridgeshire, and Norfolk, come together, and running for some distance to the north, is a place called the *Wash*, being a shallow and muddy deposit, which is left bare, to a great extent, at low water. Considerable portions of this have already been reclaimed. Where the River Nene, at the southern part of this Wash, entered into it, its channel was narrow, and crooked, and inconvenient for navigation. By laying bunches of fagots, at low water, in two lines at a proper distance from each other, so as to form two walls, — leaving a proper width for the river, and turning the channel of the river between them, — the course of the river itself deepens the channel, the mud collecting among these fagots fixes them down, and forms two solid banks; and the silt, or deposit, collecting on the outside of these walls, soon rises above high-water mark, and presently, being protected against the irruptions of the sea by cross embankments, will be converted into productive fields. The channel of the river is, of course, now made perfectly straight. As the silt, and slime, and mud collect among these walls of fagots, they are gradually raised to a sufficient height; and, by the time they are decayed, the banks will have become consolidated and permanent. The river is navigable for vessels of a considerable size; and the force of the current, being now confined and directed between these artificial banks, is sure to keep the channel free and deep. A large tract of valuable soil will thus be redeemed from the sea. The Rev. Dr. Buckland and myself were conveyed, by the politeness of the superintendent of these works, in a boat, three miles down this artificial river, and sympathized in warm admiration of the ingenuity and success of this noble enterprise. The result of this great work is not merely to deepen the river, to render it navigable, and to redeem a large extent of land from the sea, but the channel furnishes a natural drainage for the very extensive fen lands above on the river, and in the vicinity into which their waters will naturally be poured.

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XCVII. — WORK IN IRELAND.

In Ireland, on the River Foyle, below Londonderry, where it widens into a lake, a great work is going on in redeeming a large extent of land from the sea. At the recession of the tide, an extensive surface is left exposed. The plan is simply to enclose the land by a strong stone wall, or embankment, which will effectually exclude the sea. The work is as yet in embryo, though a large extent of wall is visible. I was told it would include full 2500 acres; but the source of my information was more casual than authentic. After it is once securely enclosed and brought into cultivation, it appeared to me there would be no difficulty in irrigating at least a considerable portion of it, by water from the neighboring hills. I do not know that this is a part of the plan.

The example is one of bold enterprise, and is undertaken by one of the city companies in London, who have large funds at their disposal. I refer to it, hoping to induce my readers to reflect for a moment upon the essential difference, in the investment of capital, between that which is accumulative and productive, and that which is unproductive and deteriorating. If a man spends one hundred thousand dollars in the erection and adornment of a house far beyond his needs, the capital invested makes no return; the house is liable to continued wear and decay; and a large expenditure is required, not only to live in keeping with the establishment, but to keep up the establishment; and, if some allowance is to be made for the pleasure enjoyed in this display of the owner's vanity, and gratification of his pride, it must be regarded as a pleasure not of a high character, and almost purely selfish. On the other hand, capital expended in the redemption of land from the sea, or in the improvement of waste lands, becomes at once recuperative; the crops soon give a greater or less return; production quickens and increases production; power in this case, as in many others, grows by the action of its own energies; useful labor is called out; human food is increased, and human comfort is provided for. The eye of the observing traveller rests with grateful delight upon these beneficent triumphs of human art and industry. The performers of such good and, oftentimes, grand works, in the works themselves, erect to their own honor monuments far more glorious, in the estimation of true philosophy, than equestrian statues, or marble mausoleums, or even the mighty pyramids of Cairo — the altars where human toil and life were recklessly and criminally sacrificed to despotic pride, and to an ambition of renown which has no place among those virtues which truly adorn and elevate our nature; a desire of a vain immortality, which, in this case, seems to have met with a remarkable moral retribution, in that even the names of the founders of these wonderful erections remain beyond the deciphering of human skill.

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XCVIII. — DRAINAGE.

I come now to speak of one of the cardinal improvements in English husbandry. I mean the drainage of the soil.

1. **The Importance of Drainage.** — It happens with water, as with that other most important and useful element in nature, fire, that, while under certain conditions it is indispensable and most beneficial, under others it becomes prejudicial and destructive. Water is an essential element in vegetation, and, supplied under proper and favorable circumstances, is most conducive to

its luxuriance and productiveness; but in excess, it is either wholly destructive, or produces only that which is worthless or pernicious. Every one knows this; but it does not come within my province to go into a philosophical discussion of the properties of water as a constituent of vegetation, or of the modes in which it is supposed to operate. An excess of water in the soil prevents the access of the air, which is essential to the health of the plants. It reduces the temperature when it becomes stagnant in the soil. It favors the approach of frost, so that crops are often cut off, in low places, which, but for the wetness of the soil, would otherwise have been fully and seasonably matured. It renders the working of the soil difficult and laborious, and very often impossible.

The removal of an excess of water from the land is the object of drainage, as the throwing of water over the land is the object of that other great and most beneficial operation of husbandry, irrigation, of which I shall speak in its proper place.

Lands may be injured from excess of water in three different ways; first, from being flooded by the tides of the sea; second, by permanent springs in the land; and, third, from the retentive character of the soil, holding fast, like a sponge, the rains which fall; and perhaps from the formation of the land — the water having no chance to escape. These causes may operate singly, or, to a degree, in combination. There are cases in which, where the sea itself does not reach the lands directly, yet it forces back sometimes a fresh-water stream, by which the land is flooded, and the same injurious effects are produced.

Much land in every country is perfectly useless and worthless from these several causes. The question, however, whether the drainage of it will prove remunerative, involves a variety of considerations, and many of a strictly local character, which must be taken into view by persons who propose to undertake the drainage of their lands, but upon which it would be impossible for me to enter. There are considerations, connected with the subject, which are not to be measured by a pecuniary standard, but whose importance cannot be over-estimated. I mean, for example, such as refer to the health of the country. The fogs and dampness, arising from wet and undrained lands, are a prolific source of ill health and sickness. Tracts of land in England, which were liable to fevers and agues, and consumptions, by a complete drainage have become salubrious, and are now upon an average standard of longevity with other parts of the country. The question of the expediency of draining, in some cases, resolves itself, as in the case of the redemption of peat or other waste lands, into a question of the value of the land after being reclaimed. The cost of drainage may, in some instances, be more than the land is worth after the drainage is effected, or it may be quite equal to its value; but, if it be worth nothing in its undrained condition, the operation may be considered as an actual purchase of the land; and the real satisfaction which a good mind finds in effecting such improvements, and the useful employment of labor, and the productive investment of capital, may all operate as reasonable and strong inducements to such undertakings.

2. EXTENT OF DRAINAGE, AND EMBANKMENT AGAINST THE SEA. — The tracts of land which have been redeemed by drainage of the first kind referred to, in England, are very great. I mean now to speak of lands which were either covered by the sea at every tide, or by occasional overflowings, or by the rivers which bounded these lands being, at occasional high tides, forced back, to the overflowing of the adjacent lands, or, otherwise, by the waters, from higher grounds, which flowed into these lands, not finding a ready exit into the sea. These lands, which were thus rendered mere bogs, in many cases scarcely accessible, or, otherwise, only wastes producing nothing, have, by drainage and cultivation, become the most productive in the kingdom.

I have a good deal of diffidence in stating the extent of these redeemed lands, because I have not found it possible to authenticate, as fully and as exactly as I could wish, the statements which have been made to me, and I am a little at a loss as to the geography of the district. The level of Ancholme district is represented as containing 50,000 acres.* This amount is liable to be covered by the streams flowing into it in time of flood. "The Ancholme valley, for the most part, lies below the level of high-water mark of spring tides. It is probable that at no very distant period it was overflowed by the tide. The mouth of the River Ancholme, emptying into the Humber, would frequently become blocked up by the deposit of alluvial matter, and thus the drainage water from the interior would be obstructed, so that, at times, the level would be completely inundated, and, even under the most favorable circumstances, would never be properly drained, and necessarily become a vast stagnant marsh, more or less intersected with streams and pools of water, according to the particular state of the season, and the ever-varying condition of the River Humber, into which it discharges its water." The Bedfordshire level is stated to contain 300,000 acres; and a company is now formed, who propose to redeem 150,000 acres more. They have already begun their operations. All these tracts are on the north and north-eastern side of England, and adjacent to each other.

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* "The level of Ancholme consists of a tract of low land, situated on the south side of the River Humber, about ten miles below its junction with the River Trent, and contains about 50,000 acres of land, of which only about 17,000 acres are subject to taxation. The district is bounded on the east by an elevated ridge of chalk hills, extending from the Humber, for a distance of nearly twenty-four miles north and south; about 100,000 acres of the land of this ridge drain into the Ancholme. On the west there is an inferior ridge of oölite and sandy lime-

I have been through a very considerable portion of this district; and, where formerly the lands were covered with the tides, or otherwise rendered inaccessible or incapable of cultivation from their wetness, populous villages are now found, and farm-houses, surrounded with cultivated fields in a state of the highest productiveness, meet the eye continually. The whole amount drained and redeemed is stated to be full 500,000 acres.

3. The Ancholme Drainage. — The commencement of the great work by which these lands have been drained dates back to an early period. There are said to exist in England, particularly on the banks of the Thames, works of embankments, to exclude the water from the land, which were made by the Romans. The plan for redeeming these fen lands was laid, and its execution commenced, as early as the middle of the thirteenth century. Its most important improvements were commenced

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stone hills, which divides it from the valley of the Trent; about 50,000 acres of this ridge drain also into the Ancholme. On the south it is bounded by a low ridge of diluvial hills, which divides it from the valley of the Witham; and on the north is situated the River Humber; so that the total quantity of land draining into the Ancholme may be said to be about 200,000 acres." — *Journal of Society of Civil Engineers.*

later than the middle of the last century. Some of the earliest improvements were the work of individual enterprise. A gentleman of capital undertook the draining of a large extent of land, upon condition that, if he effected the drainage, according to his contract, a certain amount of the land so redeemed was to accrue to him, by way of remuneration. Later improvements were effected under the direction of companies associated by an act of government for that purpose, and empowered to assess a tax for the accomplishment of their object.

If we take the district of the Ancholme River, and describe it, it will present a favorable opportunity for considering the whole subject. The Ancholme is a small and sluggish river, emptying into the Humber at some distance from the sea, but not above the influence of the tides. The Humber, being a larger river than the Ancholme, in its high course of tides forced back the River Ancholme on to the flat lands in its neighborhood, to their ruin as far as cultivation was concerned; and the level was often flooded by water from the hills, brought down by several streams which emptied into the Ancholme. The River Ancholme was likewise used for purposes of navigation, several villages being reached by it. Three points were then to be kept in view, in any improvement which should be undertaken. The first was, to preserve the navigation of the river; the second, to exclude the tides; the third, to prevent the land from being flooded from the rivers or small streams which came from the neighboring hills upon the level. Under the direction of scientific and skilful engineers, these objects have been accomplished.

By a sufficient embankment at the mouth of the river, the entrance of the tides was effectually prevented. But a sluiceway, or lock, was constructed here for the admission of vessels of such size as the river was capable of receiving, and the bed of the river was straightened and enlarged. In order to receive the waters from the high grounds, canals of a suitable size were formed on each side of the level, which intercepted the water in its descent, (and are vulgarly called *catch-drains*,) and conveyed it to a point where it was poured into the Humber, and so reached the sea. In order to prevent the dirt washed from the neighboring high lands from being poured into this canal, weirs, or dams, were raised across these small streams, in the course of their descent, where this mud would be deposited; and it might then be taken out by the farmers for the purpose of enriching their land. These "catch-water drains," as they may be called, afford another singular advantage. The water received in them is fresh water, and they furnish an ample supply, in their whole course, for purposes for which it may be wanted. It has been suggested that, in some cases, it might be used for purposes of irrigation, though I saw no examples of this application of it. An eminent engineer, Mr. Smith, of Deanston, has suggested that "it would be practicable to make use of the high land water, collected in the catch-water drains, for working water-wheels, either for draining the lower fens, if any existed, where natural drainage was impracticable, or for other useful purposes, either of agriculture or manufactures."

At the sluice-way or entrance into the Ancholme, large gates are erected, which open with the ebbing, and close with the flooding tide, thus preventing the access of the tide, excepting at pleasure, and favoring the egress of superfluous water at the descent of the tide. It is deemed desirable, in these cases, that water in the main drains should never rise higher than within four feet of the surface of the soil. This, while it leaves an ample soil for cultivation, gives an opportunity of cutting cross drains into the main drain, and at right angles with it, where there is any superfluous water in the soil to be drawn off. To this kind of drains I have already referred, in speaking of the redemption of peat lands in Lincolnshire.

4. Embankments against a River, and Discharge of Water by Steam-Engines. — There are cases in which a river requires to be embanked out, and its overflowings upon the adjoining lands prevented, by what, in a similar case at New Orleans, is called a *levee*. Here the great River Mississippi flows high above the city; and the city is protected from its invasion by a high embankment, partly natural — that is, made from the deposits of the river, — and partly artificial, and extending high above the city, and guarded against being broken in upon with the greatest care. In a similar way, a river is sometimes conducted through a drained fen, the surface of which is below the river. The course of the river is straightened by high embankments being thrown up. The earth to form these embankments is taken from the drained side of the embankment; and thus a deep

ditch is formed, at its base, through its whole length. This ditch itself serves to receive the waste waters from the drained land; but as they have no chance of escape, unless, in some cases, by a tunnel formed under the river, and conveying them to a lower locality, and when rising nearer than within four feet of the surface of the drained land, affecting injuriously its condition, a steam-engine is employed to raise and discharge the water, and thus relieve the land from it. This was formerly attempted by windmills, which could of course not be depended on, and were both expensive and ineffectual. It is now done by steam-engines. These move a power-wheel of large diameter, which revolves in a chamber walled with stone, resembling the lock of a canal, in which it moves with great precision, and so as barely to clear the sides. The water is forced up on the paddles, and, at a sufficient height, is thrown over the bank or gate into the river.

5. The Deeping Fen. — At Podes-hole, which I visited, there are in operation two steam-engines of the most beautiful construction — the one of sixty, and the other of eighty horse power; and these are effectual to the draining of 40,000 acres of what is called the *Deeping Fen*. The upper part of these lands, which are thus drained, was peat meadow; the lower part was salt marsh. These lands are now in the highest degree productive; producing fine crops of wheat, oats, potatoes, and swedes, besides furnishing the very best of pasturage and hay land. There is found to be a difference in the qualities of the grass; the lowest lands are fed with sheep, and the highest with cattle. Barley is not cultivated on these lands; but, besides the crops above mentioned, mustard, woad, and chiccory, are extensively cultivated. Four crops of wheat have been taken in succession from these lands, without manure. As the last crop was less than the former, the land was then laid down to grass. The rent of these lands is 38s. and 40s. per acre; but this must be considered as a moderate rent for lands so valuable. By means of these steam-engines, the water is kept down to the desired level. It is not found necessary to work them at all times, and the power is sufficient to meet any extraordinary emergency.

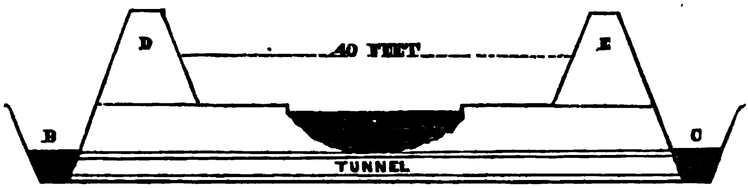
6. The Muston Drainage. — These improvements are so extraordinary, and I may say so truly magnificent, that I shall

be excused for dwelling longer upon them, and for giving some communications, with which my personal friend, Sir George Cayley, who has been largely concerned, has been kind enough to favor me.

"The general plan of the Muston drainage, intended to drain about 10,000 acres, near Scarborough, might be thus stated. The small rivers, Hartford and Derwent, with several brooks, held their courses through an extensive marsh, and, in times of heavy rain, they overflowed their banks, and flooded the land to a great extent. No expense whatever was incurred for cutting channels deep enough to convey away the flood-waters of these rivers or brooks; but they were allowed to keep their ancient levels, and embankments were made near them on each side, by cutting deep back drains, for carrying the dead water from the lands, and casting up the soil, excavated from them, on to the sides next the rivers or brooks. By this process, all the great body of water was conveyed in times of flood, within these embankments, to the lowest outfall; and the deep cutting which was considered the *sine qua non* of an efficient drainage, and the expensive part of it, was entirely confined to such moderate-sized drains as were sufficient to convey the dead water from the land. Another practical advantage of the deep back drains being contiguous to the embankments, was that, when they received any injury from cracking, after long droughts, or the burrowing of moles and water-rats, and thus permitted the flood-water to pass in some degree through them, the back drains interrupted it, and preserved the land from injury."

7. DRAINAGE AT SCOMPTON. — In addition to the above, I will give the account, with which he has also favored me, of the draining of his own private estate at Scompton.

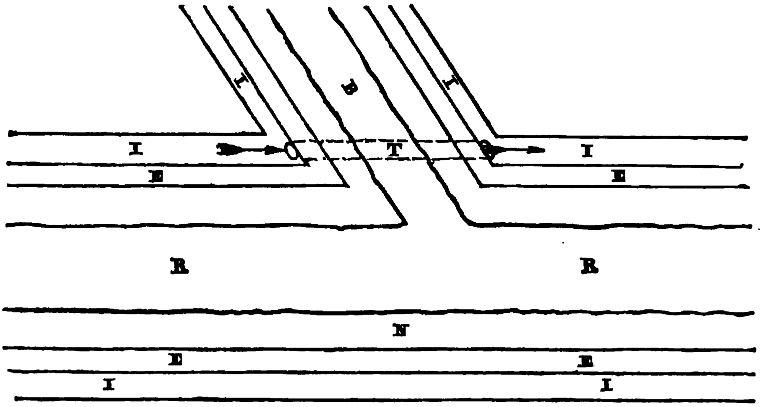
"With respect to the leading features of drainage, on the great scale of operations, I sent you some reports of the Society of Civil Engineers, in which, near the end of the papers, you have a short account (given above) of the principle I previously named to you as having been applied in draining my own estate at Scompton, of which place you had spoken in your first number, with reference to other matters. As there is no plan or section of these drains given, and as the subject is of first-rate agricultural importance, I will give you these in a rough way, sufficient to make the matter intelligible at a glance."



"Suppose A to be the section of the bed of a brook of living water, running through a marsh, which ordinarily keeps within its banks, and that this section contains any given number of square feet — say 30. Then estimate, from the best authority, what section would convey its highest floods, and suppose it, for example, to be four times the usual bed, or 120 square feet. Then, as the banks should not be calculated to hold more than four feet depth of water, they must be placed at $\frac{120}{3}$, or 40 feet apart; and the back drains, B and C, will be placed so as to form the embankment D and E, thrown up from their excavation at the required distance from each other. It is, however, better in practice to give most ample room between these, as it is much safer, in times of flood, to permit the water to spread over more land, and be shallow against the banks, than to spare the land, and have deep water ready to take fearful advantage of any flow or derangement in them, consequent upon cracks from long periods of dry and hot weather, or the burrowing of water-rats and moles, &c."

"The meandering nature of the rivers and brooks, in low marshes, often leads them into courses disadvantageous for conveying the whole mass of the dead water, collected in the back drains, from the lands drained into them; and although it is best to let them pretty strictly accompany the rivers or brooks, yet, when there occurs a better outlet at the termination of the drainage on one side of the river or brook than on the other, it may be necessary to connect these drains, under the brook or river, by a circular or other brick tunnel. Cases also occur where brooks, with their accompanying embankments and side drains, have their natural course into rivers with the same accompaniments as in the sketch" on the next page.

"Here it becomes necessary to lay a tunnel of sufficient size to convey all the water of the back drains, on the side next the brook, under it, as shown in the former sketch, and here by dotted lines."

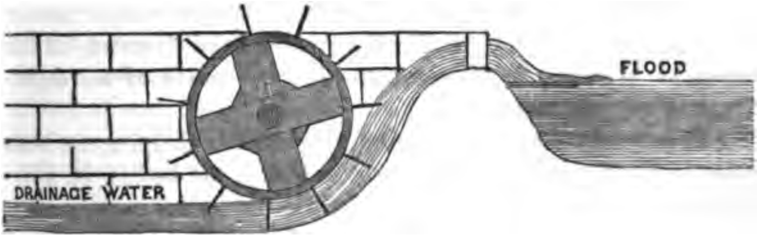


EXPLANATION.

I.... Back Drain.
B.... Brook.
T.... Tunnel.
E.... Embankment.
R.... River.
N.... Natural Soil.

"These tunnels are rather costly; but being, in most cases, few in number, form no great objection to what, in all other respects, is the most cheap, and often the only effectual plan of drainage in extensive marshes. When the back drains, in ordinary seasons, have the surface of their water about four feet lower than the natural soil, it gives sufficient fall for effectually draining the adjacent land by the usual ditches, under-drains, &c. Where, on a minor scale, bogs are fed, at the foot of rising grounds, from springs below the surface, it has been found impracticable to drain them, but by intercepting, by a very deep catch-water drain, the springs from entering the bog. No drains, however deep or large, below the bog, will dry the land, for it has to pass through the land, and cause it to be a bog before it is led off."

"P. S. It has occurred to me that you ought to be aware how extensively steam power has been employed, in Lincolnshire and other flat counties, in draining land where the natural fall is insufficient. My own case at Scampton reminded me of this; for although, when I first drained that estate in the way I have described, there was a sufficient outfall, yet, when my neighbors began to find out the benefits of draining their land, they embanked against me; and thus, in time of flood, my old outlet was inefficient, and I have been obliged to eke out my former drainage by expending six or seven hundred pounds in a twelve-horse power steam-engine, which has proved quite sufficient to keep the estate dry in the highest floods. I believe there are about 400 acres of land subject to flood, without the means of keeping it out. The steam-power is applied to a simple water-wheel turning freely in a walled watercourse, which terminates in a curve, which rises over the top of the embankment, necessary to keep out the flood-water of the river that flows below the estate."



"The power is so adjusted as to give the water in the drain just sufficient velocity to rise over the embankment; and the wheel does not touch the walled trough in which it works, either on the sides or bottom, so that there is no friction but on its axis. I am informed, where these engines have been employed extensively for otherwise unreclaimed morasses, the expense is trifling, compared with the profits of the land thus brought into cultivation."

8. **Drainage in Nottinghamshire.** — A tract of land of about 6000 acres, in Nottinghamshire, on the northern boundary of this county, called *The Cars*, has been drained in a similar way. The general impression is, that the sea once flowed over this territory. Half a century ago, this morass was first attempted to be brought into cultivation. At that time it was absolutely a bog, and no horse could be used in ploughing it. The first attempts at draining it were not successful. "In 1828, a steam-engine was erected, of forty-horse power, at a cost of £6000, for lifting the water by a wheel. The engine is placed upon the main drain, about three quarters of a mile from the River Trent, into which the drainage of these Cars empties itself; but, unfor-

tunately, when high tides flowed up that river, there was frequent interruption to the drainage, from the water in the river being higher than that in the drain; and it would have flowed in upon the Cars, had not flood-gates prevented it. By placing the engine at some distance from the Trent, a reservoir was then formed in the main drain, within that space flanked by high banks; and so, by lifting the water into this reservoir, to a higher level than the water of the Trent, it is enabled to fall into that river at all times." *

9. DRAINAGE AT WISETON. — I will insert here a brief notice of a drainage effected by the late estimable Lord Spencer, on his estate at Wiseton, in Nottinghamshire, by means of an eight-horse power steam-engine.

"Five hundred acres of swampy meadow land, lying on both sides of the River Idle, and nearly as low as the bed of it, bearing only coarse aquatic grasses, of little value, not worth more than 15 s. an acre, to rent, are now worth full 25 s. The cost of the engine was £520; the necessary buildings, and iron pipe (twelve inches in diameter) lying under the bed of the river, £400. For this outlay of capital, and the annual expenses of coals, and labor to work the engine, not exceeding £60, there is an increased annual value of £250, on this part of the estate. Besides this, the engine, whilst throwing up the water to convey it into the river, grinds the corn; cuts turnips, hay, and straw; pumps water for the cattle, in the yards and houses, — and would, if required, thresh all the corn. Had there been a thou-

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* "The wheel for lifting the water revolves between two stone walls, in a space of about 27 inches wide, through which the whole of the water is driven. The wheel itself is formed of cast metal sides, with wooden paddles between, placed ingeniously at a certain angle, which enables the wheel to lift the water above its own centre: thus a wheel of 33 feet diameter creates an artificial drainage equal to more than its radius of 16½ feet. Flood-gates are again placed immediately before the wheel, to prevent the water coming back on the wheel ceasing to revolve. Absolute command of the water is now effected; and a provision has been made, of incalculable value to the occupier of these Cars, by introducing, during the summer months, water, from the adjoining River Idle, as a supply for the stock."

"The total cost of two engines, for the purpose of this drainage, has been little less than £12,000, and the annual expenditure of working the engines, and cleansing the drains, is from 3 s. to 4 s. per acre." — *Corringham's Report of Agriculture of Nottinghamshire.*

sand or more acres of the land, the engine would have drained it, with scarcely any additional expense." *

10. Grandeur and Value of these Improvements. — I have had peculiar pleasure in giving my readers an account of these magnificent improvements. They present most striking and beautiful examples of the application of capital, labor, and skill, in the actual creation of wealth, and of wealth itself of a reduplicative character, and full of beneficent and enduring results. Thousands and millions, the produce of severe toil, are often wasted upon useless bawbles, upon idle pageants, upon objects of mere luxury and parade; and, when the sun goes down, the show passes away as a mere dream. I say nothing of the moral results of such exhibitions, which are but too often not indifferent merely, but pernicious. But here we witness the glorious and enduring triumphs of art and science; the useful application of labor; the means of human subsistence and comfort largely extended; the waste places enriched, the barren made fruitful; the solitude peopled; a wide territory peacefully rescued from the sea, and converted into the abodes of industry and plenty; and desolate sands and sunken bogs transformed into cultivated fields, waving with golden harvests.

11. Relation of these Improvements to the United States. — It may be thought that such improvements as these can hardly be looked for in the United States for centuries to come, and while so many millions of public and unappropriated lands, of the richest description, remain to be had at the cheapest rates. I am not of this opinion. The value of lands is materially affected by their situation. Excepting in extraordinary fluctuations, or seasons of inflated speculation, prices have always a tendency to equalize themselves, and to become conformed to actual values. If land in the immediate neighborhood of a city is worth three hundred dollars per acre, while land in one of the Western States may be purchased at the government price of one dollar and a quarter per acre, it is because the advantages growing out of the position of the one or the other differ in a corresponding degree. In the neighborhood of some of our large and growing cities, — of

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* Hilliard's Practical Farming.

New York, and it may be said, too, of Boston, for example, — there are extensive tracts of land, (in some cases constantly saturated with water, and rendered comparatively worthless; in others, visited regularly by the tide, and producing an inferior herbage, that might be exchanged for what would be far more valuable,) which might be embanked and drained, and reduced to cultivation, for an expense which, under such circumstances, their enhanced and constantly-increasing value would much more than repay. Such examples as I have described, if they have no direct application to the United States, cannot be without a most salutary influence in stimulating inquiry and effort; in inducing reflecting and inquisitive minds, and men of bold enterprise, to look about them, and discover, if possible, what means are within their reach of remedying evils under which they labor, of honestly improving their own condition, and with that, of course, the welfare of the community.

English husbandry, on account of a diversity of climate and soil, and because, likewise, of many circumstances in our social condition, may not be well adapted to the United States; and to follow out its rules, without a just discrimination, would be quite sure to end in disappointment and loss; but, in the perfection to which the art is carried, in the application of the most enlightened and scientific inquiry to its improvement, in the strong and indefatigable interest taken by persons of the highest influence in its advancement, and in the actual gains and various improvements which it has already accomplished, it reads a most important lesson, to the farmers of the United States, to remit no exertion, and to apply all their energies to the advancement of an art involving the most wholesome and an unexceptionable application of labor, and constituting the great source of subsistence and comfort, and the basis of national wealth.

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XCIX. — THE DRAINAGE OF FARMS.

1. **Climate, and Condition of the Soil.** — The climate of England, from its high latitude and insular character, is not damp merely, but wet. On the western coast, and far to the

north, they are much more subject to rain than on the eastern coast. The frequency of rain, and the suddenness with which the showers collect and compliment the unsuspecting traveller or pedestrian with a bath, and the many days — and I may almost add weeks — during which the sun never makes his appearance, or, if seen at all, it is with a veil over his face, as though he were distrustful of his welcome or ashamed of his long absence, forcibly remind the visitor, if he has come from the other side of the Atlantic, any where south of the British provinces, that he is from home. There is a compensation for this in an equable temperature, which is exceedingly grateful; in the indifference with which the habits of the people, most of whom seem as regardless of a good ducking as so many water-fowl, soon induce you to look upon it; in the brilliant and deep verdure of the country, which in many cases remains unchanged, and converts February into June; and in the fine, clear, ruddy, and transparent complexions which characterize the English; — I mean, of course, those who are not overworked, and who are well fed; the class, as a member of Parliament significantly denominated them, of two meals a day.

The effect of such a climate upon their land is what we should expect; and a large portion of it is fully saturated with water, rendering it difficult of cultivation, and endangering or injuring the crops. To cultivate wet lands is quite out of the question; and, therefore, efforts to drain the lands have been made, with more or less skill and success, probably as long as the land has been cultivated.

2. **Modes of Draining. Open Ditches. Covered Drains.** — The rudest mode of draining, and that, without doubt, first adopted, was that of open ditches. The unsightliness of such ditches, where they are numerous, the inconvenience of crossing them, the actual loss of land incurred in their formation, the constant wear and falling in of the banks, the labor required in keeping them open and in repair, with many other obvious objections, are quite sufficient to prove them ineligible. Covered drains were early substituted for them, and various forms of these have been adopted, all of which I shall not undertake to describe.

It is desirable, in drains, that they should, as speedily as possible after rains, or from whatever source the wetness may come, relieve the land from it. Several things are therefore to be considered — such as the capacity, the depth, and the direction of the drains, the distance at which they should be placed, their outlets, and the mode of their formation. The expense of draining must, in all cases, be considerable. The materials employed in their formation, and the permanency of the work, are essential points to be considered. The great improvements made in draining land, in England, have been the work of the past few years; in no branch of husbandry has more been gained; and the results have been in the highest degree valuable and important. I believe I am safe in saying that, in what it has done, and what it promises to do, for the advancement of agriculture, no other process of improvement can be compared with it.

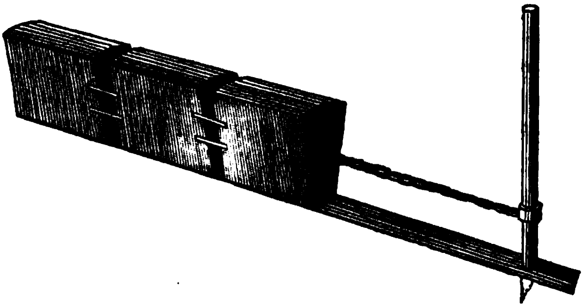
3. **Elkington's System of Drainage.** — It is but few years since Elkington — a name well known in English husbandry — effected a great improvement, by what might be termed *tapping the springs.* It was generally supposed, at least much more generally than at the present time, that the wetness of land proceeded from springs, gushing up spontaneously, and supplied from internal sources, much rather than from water falling upon the surface. It is well known, likewise, that a large portion of the earth's surface is in layers, or distinct strata, somewhat like the leaves of a book lying upon its side, and, in some cases, not flat, but with its side raised up, and, as the geologists term it, *dipping* one way or the other, at different angles of inclination. In effecting the drainage of a low piece of land, Elkington's first plan — and this was the plainest dictate of common sense — was to cut off the water by a drain formed at the foot of the elevated ground, and round the whole margin of the meadow. By this drain the water from the high lands, whether proceeding from permanent springs or from the infiltration of occasional rains, was intercepted, and, if possible, conveyed away. I have seen this done repeatedly and successfully, and the meadow, when thus insulated, made quite dry.

But there were other cases, in which it happened that the water falling upon the land, though it might pass through one or two of the upper strata, would meet, in its passage down, with an indurated and impermeable stratum or layer, by which it would be held fast, and presently the whole surface become saturated with wetness. In such cases, by piercing forcibly through this stratum, or by digging wells in different parts of the field, which would go through it, a more open stratum would be reached, and, in this way, the whole land be completely drained. This plan would sometimes succeed, where the geological structure of the land favored it, and obtained for him great celebrity and most extensive patronage; but, for obvious reasons, it must sometimes fail, and large expenditures were occasionally followed by severe disappointments. The discovery of this mode of drainage, which excited great attention at first, seems, like many other important inventions and discoveries, to have been the result of mere accident; the circumstance of a laborer having forced a crowbar, through a solid stratum of earth, into an open, porous, and gravelly subsoil, by which means a large quantity of water was made to disappear, having induced to other experiments, which proved successful. There can be no doubt that Elkington's practice might still be adopted with success in many cases; but it is not now regarded, as at first, like the patent medicines which we see every day advertised as certain to cure all diseases.

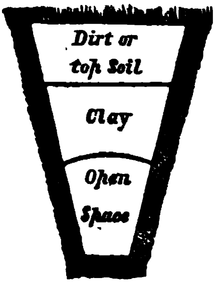
4. Draining with Fagots and Straw. — Various methods of draining land had been practised for a great length of time before this, and many of them are still continued; and, though they may not come in competition with the most improved modern methods, yet they frequently may furnish a useful substitute, and in some circumstances, and in certain localities, may be most eligible. In some cases, after the drain had been dug, it was filled in with fagots, over which the soil was returned and pressed down. In some cases, a rope of straw was placed in the bottom of the drain, and the drain filled in over it, so that, when it decayed, it left a passage for the water. These were, of course, imperfect modes of draining, and the drains could not be considered as very permanent. The filling up was merely intended to remain until the earth had become consolidated, and an arch was formed.

5. Plug-Draining. — In some places a mode of draining, which is called *plug-draining*, is still in use in stiff clay soils; is executed at a comparatively small expense; and, though not so

permanent as some other modes of draining which I shall presently describe, is yet considered sufficiently enduring fully to remunerate the expense. In this case, after the drain has been fully opened, some wooden blocks, chained closely to each other, of the shape and size of which it is desired that the drain should be, are placed at the bottom of the drain. The clay is then filled in carefully over them, and hard rammed, and then the turf and other dirt returned upon the top of that. The plugs are then drawn forward by means of a stake in front of them to which they are attached, and the filling in proceeds until the whole is completed. This drain, if well made, will last many years. I see no advantage in this matter of having the plug in different blocks, unless in a case of the drain varying from a straight line; and it would seem as though a single solid plug or stick of the proper size and form, which is sometimes used, would serve the purpose in view still better. It is always safe to infer, however, in respect to any practice which has long prevailed, when other modes may have suggested themselves as preferable, that it has some good reasons to recommend it. The size of the plugs may vary according to the size which it is desired the drain should be; but I will give the size which is sometimes recommended. The blocks, then, may be eight inches in height, six inches in length, four inches wide at the top and two inches wide at the bottom, and fastened together by strong links of iron. To the forward block an iron chain is attached, by which the whole is drawn forward by means of the stake or lever in front. I found one of the best farmers in England engaged in making drains, upon a considerable field, of this description, deeming them economical and effectual; and it is said that "one farmer has, within four



years, made 300 miles of this kind of drain," and is satisfied with its operation. A section of the drain is represented in the engraving.



6. **Draining with Turf Covering.** — Another mode of draining, somewhat similar, is, after having made the drain tunnel-shaped, as above described, leaving two shoulders at the height from the bottom it is desirable the drain should be made, then to take the sod which was taken from the top, and, inverting it, place it upon these shoulders in the drain, and then fill up with the dirt which has been taken out. Both these methods of draining, however, though comparatively cheap, can scarcely be considered as permanent. They are liable to be much worn by any considerable amount of water flowing in them, and may easily be pressed down by the passage of a loaded wagon over them.

A farmer in Cambridgeshire, on a soil of tenacious loam, shallow, and upon a subsoil of cold clay, makes his drains five yards and a half apart, and, having first opened them with a double mould-board plough, making a deep furrow, a spade follows, and, after taking out to the depth of the spade, the drain is dug with a suitable instrument twelve inches farther; the width of this aperture is about three inches at the top, and gradually reduced to one inch at the bottom. The drain is then perfectly cleared by a hoe or a scoop. Peat-turf, procured from the fens, and cut into lengths of from twelve to sixteen inches, and about three inches in thickness, is then pressed into the lower part of the drain its whole thickness, leaving a passage for the water, underneath, of about nine inches in depth. The peat expands by moisture, and becomes very firm. It is said these turf drains have been found in a sound state after having been laid for sixteen years; but it is recommended to renew them every eight years. This is certainly a very simple and economical mode of draining. The durability of the drainage depends upon the soundness of the clay; the depth in the earth at which the turf is buried; and the quality of the turf, its strength, and firmness.*

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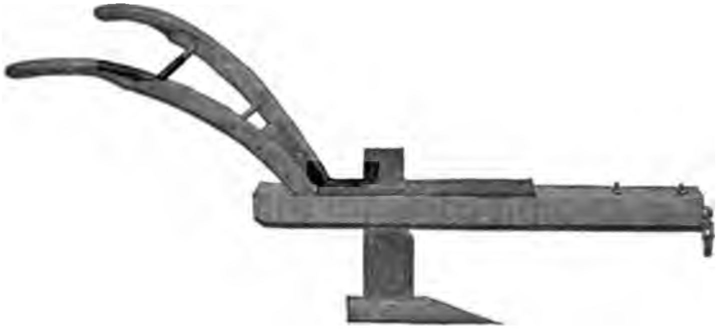
* Journal of Royal Agricultural Society, vol. ii. part 11, p. 262.

7. **Draining by the Mole Plough.** — Another mode of cutting a drain is by what is called a *mole plough.* This plough consists of a straight and strong beam, to which two handles are attached, and a single piece of iron or straight colter, passing through the centre of the beam, and capable of being graduated, like a common colter, by means of wedges, to such a depth as it is desired to go. To the foot of this iron is attached a piece of iron, round like a gun-barrel, or round at top and flat at bottom, of the diameter of which it is intended to make the water-course, and pointed at the end.



After being once placed at the proper depth, this is forced through the land by a strong team; but a better way is to force it on by a movable windlass, which is made to revolve by a horse attached to the lever. The chain being thus wound up, the plough is forced through the ground a short distance, and then the windlass is moved forward, and another purchase is taken. I met with this machine only on one farm; but I could easily infer that the difficulties attending its use were not small. It could only answer upon clayey land. Upon stony ground it would meet with insuperable obstructions; upon gravelly or sandy soils, the drain would often be filled up as soon as the instrument had passed. Upon clayey and adhesive soils its effect would be more permanent; and the space made by the narrow colter, or iron bar, to which the mole itself is attached, being narrow, would soon close. I cannot say much in commendation of this mode of draining; but it seems to be one of those make-shifts to which people often resort with a view to saving expense, and which yet fails to accomplish its object; while a more thorough and effectual mode, adopted at first, would have proved in the end as little expensive.

8. Suffolk Draining.—I will now allow an intelligent farmer in Suffolk to speak for himself, and describe the modes of draining adopted in that improved county.

In the first place, the line is marked out by a plough going and returning, and forming a furrow eighteen inches wide and five deep. This is followed by another large plough, which turns out another furrow ten inches wide by five deep; and thus the plough has formed a drain ten inches wide by ten inches deep. The workman, in the next place, with a common spade, digs a trench nine inches deep; and the next step is with a narrow spade to go eleven inches deeper, and with a scoop take out the loose dirt.

Scoop.

Narrow Spade.

The narrow spade is 1½ inches wide at bottom, and 2½ inches wide at top. It is in depth (the blade) 13 inches, but, working in a slanting direction, it only digs out about 11 inches.

"After the digging, a small quantity of stubble is laid along the narrow drain, and is pressed down about three inches by the spade into the narrow drain. The stubble is not pressed to the bottom, but a free passage for the water is left under it. Earth, heavy or light indifferently, is then shovelled in over the haulm," and the plough is used to assist in covering the drain.

"Sometimes heath is used instead of stubble; sometimes hop-binds twisted; sometimes a 'scud of straw' is made to fit the upper part of the narrow drain. Occasionally a wagon-rope is laid along the bottom of the drain, before the filling up is done; and the rope is afterwards drawn along, thus securing the drain from the crumbs of earth at the bottom; but this precaution is unnecessary. At other times all filling up is dispensed with, and a board (or piece of plank) of the same dimensions as the narrow drain is fitted into it; the earth is then rammed down on to the edge of the board, and the board is drawn along the drain, leaving an arched water-way behind it." An example is given of some drains, formed six years previous to the account, continuing to do well.

"Sometimes fagot-wood is laid along the bottom of the drain, with haulm over it, the water finding its way through the wood;" but this mode is deemed expensive. "But, better than all, peat cut for the purpose in the fens, in length fifteen inches, and three inches square, is pressed gently into the top of the narrow drain, and the earth thrown in upon it. The peat swells speedily, and becomes firmly fixed, and is very durable; and has this advantage over the methods already specified, and also over tile-draining, that a fold-stake driven into it commits no damage. In peat-draining, when we come to stony or gravelly spots, two pieces of peat instead of one, or one and a half, are placed side by side, or, in bad cases, the sides of the drain are built with turf, as well as the top. Stubble, heath, hop-binds, straw, are quickly decomposed and washed away; peat remains. Sir Humphry Davy says, "Inert peaty matter remains for years exposed to water and air, without undergoing change." *

9. DRAINING IN BERKSHIRE. — Mr. Pusey, whose operations I had the pleasure of witnessing, is now draining extensively after the method which I have described — the plug method. The field in which this process was going on was a stiff, adhesive clay. I do not understand him to prefer it to tile-draining, excepting on the ground of cost. The objection — want of permanence — is met by the small comparative expense. "Where the whole of a large farm requires to be drained, and the means both of landlord and tenant are limited, there can scarcely be a doubt which is best for both of them, — to drain 100 acres for forty years, or 300 acres for twenty years." All this must be matter of personal calculation, which is likely to be affected by a great variety of circumstances. The farmer must calculate the length of his lease, and the landlord the length of his life. I cannot most certainly commend the selfishness of the man who said "he should do nothing for posterity because posterity had done nothing for him;" but improvements are sometimes made so unnecessarily substantial and expensive, that the mere interest of the sum expended would build them in a way to be effective, and rebuild them as often as might be necessary to do so. Mr. Pusey refers to one fact well worthy of remark: His drainer, an experienced man, traced out the drain with a plough, and the

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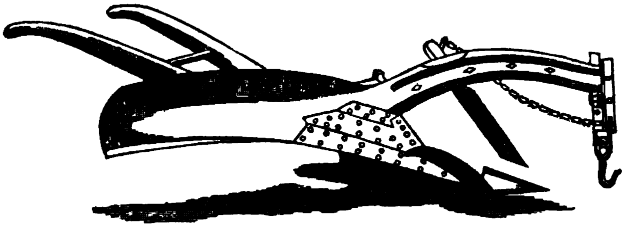
* Journal of Royal Agricultural Society, vol. iv. part 1, p. 29.

saving of expense, by adopting this simple expedient, he calculates at 2 d. per rod, which would be equal to £2 per acre. The plough opened the soil to the depth of 8 inches. These drains are made at 11 feet apart and 30 inches in depth. This kind of draining can apply only to heavy clay lands. In gravelly soils, stones or tile must be used.

10. **Scotch Draining Plough.** — At the interesting and admirable museum of the Messrs. Drummond, at Stirling, Scotland, I saw a mammoth plough designed at one operation to open a drain and sink it almost to its required depth. It was the invention of Mr. M'Ewan, of Blair Drummond, and upon low alluvial lands, or clay land, which is not too stiff, or upon what is called carse land, (which much resembles the alluvial lands on the Connecticut River,) it "effected the opening of drains to a depth of from 18 to 22 inches in the most perfect manner, and at the small cost of about 2 d. per rood of 36 yards. The size of the implement was perfectly Brobdignagian, and I had almost said terrific.

M'Ewan's Draining Plough.



"The leading principles of the construction of Mr. M'Ewan's draining plough are, — having it of such large dimensions as to turn out at once the full depth of the drain, which is the more easily accomplished by having the furrow of a wedge shape, and ample in its width, so that, when separated from the soil, it shall lift freely out; having the mould-board or inclined plane of the plough of great length, and consequently of easy slope, so that the great and weighty furrow shall be gradually raised, while, by the same form, the plough is rendered more steady and easy to hold. The furrow is taken clear out, and laid along the drain at one foot distant from the margin. From eight to twelve horses are necessary to work this plough in carse land, according to the nature of the soil; and it is probable that sixteen may be necessary in some obstinate clays. The pace of the horses must be slow, say two miles an hour; and the plough is easily directed by one man. After the plough has done its work, men follow with small spades, to take out a space for tiles or for broken stones, and to correct any deviation from the uniform fall of the bottom, caused by any unevenness in the ground. The tiles or stones are then put in, and the furrow turned in over them by the same plough."

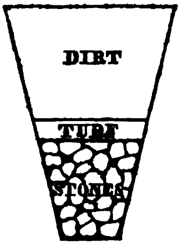
"If the horses were to move continually, at a rate of two miles per hour, they would turn out 782 roods, of 36 yards, in eight hours; but in so heavy an operation, much time is lost in turnings and otherwise, so that one third may be deducted to cover loss of time, which will leave 521 roods of work done."

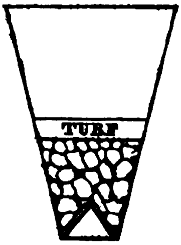
"The horses go on each side of the line of drain, the near horse of the off-side division going in the furrow, all being yoked to a strong main bar, or master-tree, ten feet long, and arranged in fours and sixes abreast, as may be necessary; four abreast when eight horses are used, and six when twelve are used. The leading horses draw from a second main bar attached to the muzzle by a chain passing along betwixt the middle horses behind. When the plough reaches the end of a line of drain, and is about to be turned, the draught chain of the leading horses is detached; and a man taking hold of the chain, the bar, resting on the ground, follows round till in a position to be yoked for the next line of drain, the plough following drawn by the rear horses. When working, each pair of horses is led by a man; one man to each range of horses, going in the middle, and leading a horse in each hand, and a man going on each flank, leading the horses next him — the steadiest man being put in the middle, to keep a direct line for the drain. The man who lifts the chain assists the ploughman in raising the plough from the drain just completed; and in going round and entering for the next drain."

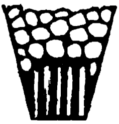
With striking simplicity the writer of this account adds, — "The drain plough, like all things else of the same magnitude, and when in the hands of inexperienced persons, requires great patience and perseverance, especially when applied in a land of a hard and stony nature, and can never succeed in the hands of impatient and careless people. But to those who take time and pains to have their men and horses fully broken in to the work, there will be an ample reward in the cheapness and expedition with which the drains shall be executed."

I have given the account of this implement to my reader, if indeed he has had breath enough to get through it, rather as matter of curiosity, than with even the slightest expectation that such a machine could, with any possible advantage, be introduced into my own country. Yet there are persons who bear testimony to their having used it to accomplish a large extent of drainage. In my opinion, such persons are of the right nerve to be sent upon a forlorn hope; and the proper team for such a machine is not a team of horses, but of elephants.

11. Draining with Broken Stones. — Underground draining has been practised, in several counties, for more than a century; and the construction of drains, by filling the bottoms with small stones, is by no means a new process. In such case, the drains were dug and filled in, somewhat after the subjoined cuts.





They were dug to the depth of perhaps 20 inches, and filled in with small or broken stones to the depth of about six inches; the stones were covered with an inverted turf, or with straw, and the dirt was thrown in upon it, and the land levelled. It must be admitted that these drains have proved of an efficient and permanent character; and, where stones are easily to be had, this form of draining, all circumstances considered, may be highly eligible, the shallowness only excepted. In some cases, the broken stones fill the whole bottom of the drain; in others, two or three flat stones are sometimes set up, thus, ∧ or ▽ or  with a view of forming a more ready passage for the water. It is obvious that the second form is more likely to keep itself clear than the former, from the water being compressed into a narrow space; and that, in the latter case, as well as where the stones are thrown in promiscuously, the entrance of vermin is completely foreclosed. Experience has suggested, in such drains as these, two or three rules of great importance. The first is, that every caution be taken against the dirt sifting in among the stones; the second is, that the drain should never be filled with large and small stones, thrown in promiscuously, but that only small stones be used; and they, as far as possible, of a uniform size.

12. **Thorough Draining, or Deanstonizing.**—I come next to speak of operations in draining which, in connection with subsoil-ploughing, may be said to constitute an epoch in agricultural improvement; and the effects of which upon the agriculture of England appear destined to be of the most extensive, permanent, and valuable character.

Mr. Smith, of Deanston, near the village of Doune, in Scotland, (of whom I have before spoken,) conceived the plan of laying his fields thoroughly dry by a careful system of drainage, and next by subsoiling his fields—that is, a mode of deep-ploughing, which, as I have described in a former number, consists first in ploughing with a common plough, and following in the same furrow with a plough of a peculiar construction, called a *subsoil-plough*, being a plough without a mould-board, by which the lower stratum is thoroughly broken up, loosened, and stirred, but not brought to the surface. The active soil is still kept upon the top; the lower, or subsoil, is rendered permeable to the roots of the plants; the air has access to it, and enriches it, and, by being loosened, the water filters through it, passing off by the drains. His operations attracted so much attention, and have led to such great improvements throughout the country in draining, that his name as a great improver is destined to be long remembered, and his system is sometimes, after the name of his residence, called "Deanstonizing." I have had the pleasure of going over the farm on which his operations were carried on, and of admiring its improved condition.

According to the method adopted by Mr. Smith, the first step is to ascertain the level of the land, so as to form a main drain in the lowest part of the land, into which the side drains may fall, and the water be led off. He recommends that the bottom of the main drain should be 3½ or 4 feet below the surface; and says that a drain ten inches wide, and twelve inches deep, will discharge the water from a hundred acres. Many persons, in undertaking the draining of flat lands, are discouraged by the difficulty of finding an outfall for the water; but he deems that one foot fall in a hundred yards, with a drain of the above dimensions, may be relied on. "It has been proved, in practice, that a watercourse 30 feet wide and 6 feet deep, giving a transverse sectional area of 180 square feet, will discharge 300 cubic yards of water in a minute, and will flow at the rate of one mile per hour, with a fall of no more than 6 inches per mile." It is his advice that this main drain should be covered as well as the side drains; but others recommend that it should be left open, that it may be always easy to watch the running of the side drains which empty into it. Three objections, which, among others, lie against leaving the main drain open, — such as the falling in of the sides, the loss of ground, and the danger of the access of vermin to the side drains, (where they are formed with tiles,) —are obviated by Mr. Morton, in an ingenious manner, as I saw on Lord Ducie's model farm. I have already slightly referred to it. The main drain, in this case, runs through the lowest part of the land; but it is made so broad and flat that the grass can be mowed down to the very watercourse, or a cart could be driven, without overturning, on the very edge or sides of it, though this would never be advisable, for fear of injury to the drains. The farm road, in this case, is made at about the distance of sixteen feet from the centre of this open drain, or brook. In this case, then, there is no loss of land, and no bridges are required in the crossing. Where the side drains enter the main drains, one link in the chain of pipes is omitted, and the remainder of the distance is laid with small broken stone, which allows of the passage of the water, but forbids the access of any vermin into the drain.

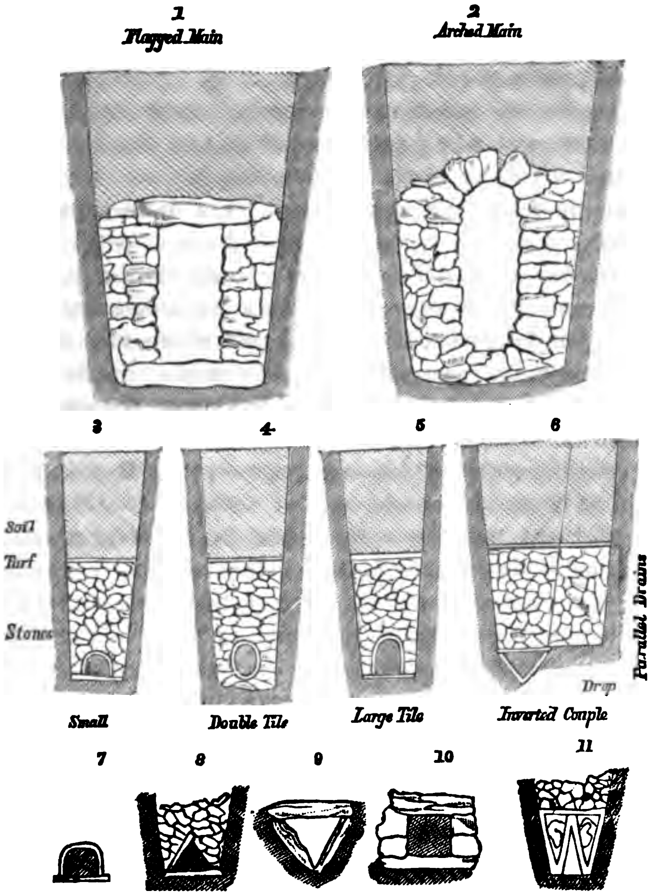
The main drain having been formed, Mr. Smith advises, next, the cutting of a drain at the top of the field, and across the whole breadth of it, from which all the side drains are to commence, and thence run exactly parallel with each other into the main drain. The depth of this transverse drain must not be more than that of the drains which may be said to take their rise from it, and lead into the main drain. Besides the great main drain, which forms the principal watercourse, the condition of the land is often such as to require submains, into which the side or parallel drains empty themselves, and by which the water is conveyed into the principal drain. This matter is so entirely dependent upon the shape and situation of the land to be drained, that no universal rule can be laid down. The number of submains, and their position, must depend wholly upon the shape and condition of the land to be drained; but the submains should be covered as well as the parallel drains which run into them.

The mains and the submains being completed, the next step is to lay out the parallel drains; and the frequency of these drains, or the distance which they should hold from each other, depends upon the character of the subsoil. "If," says Mr. Smith, "it consists of a stiff and strong till, or a dead sandy clay, then the distance from drain to drain should not exceed from 10 to 15 feet; if a lighter and more porous subsoil, a distance from 18 to 24 feet will be close enough; and in very open subsoils 40 feet distance may be sufficient. The drains," he adds, "should be run parallel to each other, and at regular distances; and should be carried throughout the whole field without reference to the wet or dry appearance of portions of the field, as *uniform* and *complete* dryness is the object; and portions of the land, which may be considered dry in their natural state, will appear wet when compared with those parts which have been properly drained."

Of the general form of the drains recommended by Mr. Smith, I subjoin a sketch, (p. 91,) which will need no illustration. The eye will at once discern the different forms which may be eligible under different circumstances.

The depth of the parallel drains should, according to Mr. Smith, be at least two feet and a half, — and he deems three feet more eligible, — so that the land may be subsoil-ploughed to the depth of sixteen inches, and the plough certainly should not pass nearer to the drain than two inches; that is, there should be at least eighteen inches of workable soil above the stones with which the drain is filled. A less depth, as far as injury to the drain is concerned, might answer; but experience has proved, most strongly, that a much greater depth than this is to be preferred for the perfect drainage of the land. The main drains and

TRANSVERSE SECTION OF DRAINS, &C.



submains should be at least six inches lower than the parallel drains, so as to secure a sufficient fall. In speaking of the inclination of the drain, so as to secure a sufficient fall for carrying off the water, I have given the minimum which should be relied on. Mr. Morton is of opinion "that 1 in 200 is the least that can be advised; 1 in 140, or 1 in 100, would keep the bottom clear of sediment." The width of the parallel drains at top should be fifteen inches; at bottom, it may be from four to five inches, according to the width of the tile with which they are to be filled, or the quantity of stones which may be at hand to fill in with; but it will be found that a much less space than this will be ample for the discharge of all the water from the land under any circumstances; and where round tiles, of an inch bore, are used, (which are getting to be decidedly preferred,) no more width at bottom will be required than merely to place the tile. Where broken stones are employed, no stone larger than will pass through a two and a half inch ring should be employed; large stones ought by no means to be used.

Practical men advise that the length of a drain should never exceed 300 yards; and, where it crosses springs of water, it should not exceed 200 yards. The rule, in making drains, is, to begin with the complete formation of the main drain, and then proceed with the parallel drains, from the point where they enter the main drain to their upper extremity. In filling up, the order is to be reversed, and the completion of the drain is to commence at the upper end, and proceed to its termination with the lower end, or with its entrance into the main drain. It is extremely desirable to have, if possible, all the drains opened before any portion of them is filled in, that their partial working may be watched, and a right inclination secured; and a very eminent and successful improver advises, where draining is attempted in a stiff soil of clay, for example, after the tiles are laid, to fill in but partially at first, leaving the land to be swollen and cracked by the winter frosts, — for, such fissures being once opened, the water will make for itself through them communications with the drain which will become permanent.

It is now an established point, and one of great importance, that, with the exception of the main drain and the submains, which must conform to the character of the land, and the point where a discharge of the waters is to be sought, all drains should be made as straight as possible; and that, where they are made on a side hill, they should proceed straight down the hill in the direction of its inclination, and never be made round it, or cut it diagonally, for the obvious reason that, although a drain made round a hill, or cutting it diagonally, might take the water from the land above it, or intercept any spring which might be found higher up on the hill, yet it would do nothing towards relieving the land below from any wetness which might proceed from rain or from springs situated below it. It is obvious, likewise, that a drain cut round a hill, or diagonally upon its side, will not empty itself so soon as one which is in a direct line down it, and that the water in such a drain is not likely to be wholly emptied by the mouth of the drain; but some of it will find its way through the side of the drain, as it flows on, and, instead of serving to drain, do something towards keeping the land below it wet. In making drains on a side hill, which empty into a main drain, though it is important always to make them straight, it would not be advisable, or even possible, to make them parallel; but, following the formation of the ground, they may, as it were, radiate from the top, and reach the main at the nearest point. This plan I saw adopted on one of the best-managed farms which has ever fallen under my observation — that of Mr. Stirling, near Falkirk, in Scotland.

Mr. Smith refers to two very important advantages in having the drains made in a direct line down the steep; that it is a security against the lodgment of any sand or mud in the drain, and that, in case of any obstruction presenting itself in the drain, the water will, by its downward pressure, force itself through, or, bursting out upon the surface, from its accumulation, indicate at once the seat of the difficulty. "Cross drains, having little declivity, are often filled high up with water, before the insidious cause of mischief is discovered." Arguments for the construction of drains straight down the hill, instead of passing round or across it, are often referred to, from the geological structure of the ground; but this varies so much in different situations, that such arguments can have only a limited application. There are cases in which the existence of some spring between the drains may require to be led into one of the parallel drains; but, in general, the water, under such circumstances, will find its own way; where this is not the case, however, a short cut or branch down the incline may bring the water from the spring directly into the side of one of the parallel drains. The tendency of water to force its way along by its own gravity, and its extreme mobility, must be obvious to every one. That which is nearest the drain being first drawn off, the neighboring portion immediately takes the emptied place, and is forced onwards, and so on, gathering accessions continually, beyond any limits which we can affix to it. A well, sunk to a more than ordinary depth, will often affect all the other wells in a very extensive neighborhood.

Such are the general and most important principles laid down by the most experienced men, in regard to the system of thorough draining, with a view to subsoil-ploughing.

Mr. Smith's directions for forming the drains are so clear and explicit, that I am persuaded my readers will be gratified to have them in his own words.

"The lines of drains having been marked off in the field, the drainer begins by cutting with a spade on a line, then removing a first spading of about 13 or 14 inches wide all along; another follows with a narrower and tapering spade, made for the purpose, taking out another spading; and, when picking becomes necessary, a third man follows with a pick, and a fourth with a large scoop-shovel, to cast out the earth; a smaller scoop-shovel is used to clean out the bottom, which should be cut as narrow as will allow the last drainer a footing, generally about 3 or 4 inches. From 2 to 2½ feet from the surface are the best depths for such drains, the latter always to be preferred. The bottom should be cut as straight and uniform as possible, so that the water may flow freely along at all places, and it is better to cut a little deeper where there is any sudden rise of the surface, than to follow it; and where sudden hollows occur, the cutting may, on the same principle, be less deep: attention to this also admits of after straightening or levelling of the surface, without any injury to the drains. The workmen, in cutting, should throw the earth to the right and left from each alternate drain, as that allows the plough to go regularly and fully occupied *boutings*, in filling in the earth, whilst each alternate ridge or space is left for getting in the stones, free from the earth thrown out. The stones may either be laid down at intervals by the sides of the drains, to be there broken, or, being broken in masses at some convenient spot, and at such convenient seasons as best suit for the employment of spare labor, can be brought by the carts ready to be filled in. No stones should be filled in till the whole line of drain has been cut out *and inspected;* but the sooner drains are completed after having been cut, the better, and they should always be filled from the higher level downwards. Sometimes, when there is much tendency of the sides to fall in, it becomes necessary to fill in going along. Cutting in the summer, when there is little water in the soil, or in any dry season, saves much of this. In soft or sandy bottoms, by cutting the drains to half the depth in the first instance, and allowing them to remain so till the water has been voided from the upper stratum of the soil, the lower part may then be cut out with more safety from falling in. The stones should not be filled nearer to the surface than 18 inches, leaving 16 inches free for deep ploughing.

"The upper surface of the stones having been made straight and uniform, the whole should be neatly and closely covered with a thin thatch or turf, cut from the adjoining surface or brought from some suitable place. *Strict attention to the correct execution of this operation is of the greatest importance, as many drains are ruined at once from the running in of the loose earth.* Thick turfs are objectionable, from the difficulty of getting them to fit close. Straw, rushes, broom, whins, and other like materials, are very objectionable, affording no certain or uniform security, and forming a receptacle for vermin; peat moss, in a thin layer, well beat down, may be used to advantage. When the deepest ploughing has been executed, there should always remain a firm crust of earth undisturbed over the stones of the drain; and no surface water should ever have access to the free way of a drain by any *direct* opening, but should find its way by percolation or filtration through the subsoil, and should always enter by the sides of the drains. It may be of advantage to tread or beat down closely the first two inches of soil put over the turf, in order to form the permanent crust."

The making of drains is a matter which requires great skill and experience. So important and expensive an operation should be executed with the greatest care. The most thorough and permanent mode of doing it will be found, in the end, the most satisfactory and the least expensive. The science and skill of an experienced engineer will be often found requisite to lay out the work, and to determine the levels, where it is to be undertaken to any great extent, either by individuals or companies; and this class of men, now so rare among us, may, I hope, presently appear. The supply of such professional men, whose services would be of the greatest utility in many cases, is a prominent object, to which I should look forward in the establishment of seminaries for agricultural education. There has been, many times, a great waste of labor and money, and most mortifying disappointments, where such operations have been imperfectly and hastily executed, or undertaken without experience or skill. Instances can be cited, where, indeed, the necessary taking up and removal of an imperfect drainage has actually cost more than the reconstruction of the whole work. The art likewise of using to advantage the common draining tools by the laborer himself is the result of training and long experience. In England, where the division of agricultural labor is carried to an extent, of which, in the United States, we hardly know any thing, there are professional drainers almost exclusively devoted to this branch of patient and severe toil, who have reached a perfection in the art and the use of the tools quite deserving of admiration. It must be a long time before we can have such a set of laborers, unless we import them.

13. **Implements for Draining.** — I subjoin, (p. 97,) for the benefit of my reader, a plate of the various implements customarily used in draining, which, I hope, will put him upon the inquiry whether he can devise any better.

EXPLANATION OF THE FOLLOWING PLATE.

Fig. 1. — Section of the Frequent Drain, with its filling of broken stones and its Set.
- *a* First Spade, common shape.
- *b* Second Spade, which follows the first, and is narrower.
- *c* Pick, used when the subsoil is stony.
- *d* Large Scoop-Shovel, for removing the loose earth after picking.

Fig. 2. — Section of the Wedge-Drain, with its Set, as used in the carse or clay soil.
- *a* First or opening Spade, same as above.
- *b* Second do. (Some use this and the following with a spur attached; but the best drainers prefer pushing with the toe on the shoulder of the spade.)
- *c* Third or narrowest Spade.
- *d* Narrow Scoop for cleaning out the bottom.

Fig. 3. — Section of the Tile-Drain, with its Set.
- *a* First Spade.
- *b* Second do.
- *c* A flat Scoop, with turned-up edge, for cleaning out the bottom.

Fig. 4. — A Flauchter Spade, used for cutting turf to cover the small stones in the frequent drain.

TRANSVERSE SECTION OF DRAINS, &C., WITH SKETCHES OF IMPLEMENTS USED IN THEIR FORMATION.

Fig 1

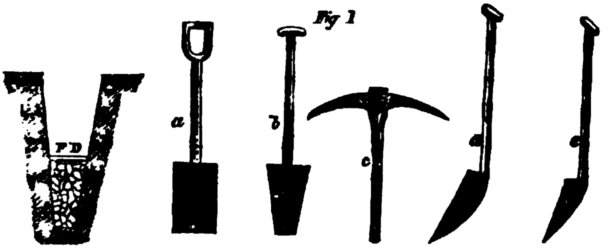


Fig 2

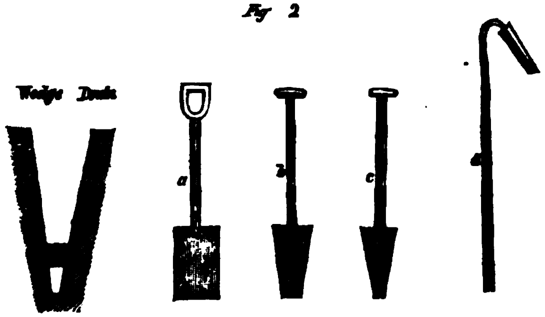


Fig. 3

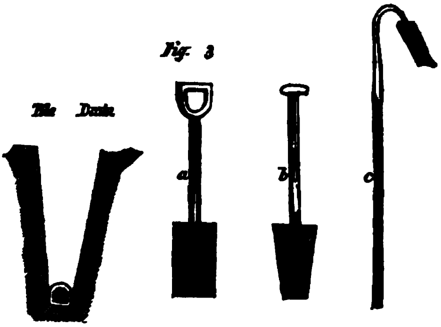
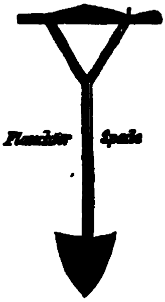


Fig. 4



C. — NATIONAL CHARACTERISTICS. — A DIGRESSION.

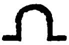
All hope of finding a Yankee skilled in the use of the spade, or able, or willing, whether able or not, to cut a drain with the same neatness and exactness as an Irishman, or a Scotchman, or an Englishman would do, must, I think, be given up, at least for the present. They are not accustomed to apply themselves so steadily to a minute object. I have never yet found one, who could, or, if he could, was willing to make a straight drain. There are about them a hurry and carelessness of operation, what is vulgarly called an independence of temper, a conceit of their own superior sagacity and knowledge, and an impatience of being taught, — a necessary result, I believe, of our free institutions, and the general diffusion of a moderate education, which refuses to be commanded or directed. This is a temper of mind, which, I acknowledge, has its advantages, and is a great spur to improvement, but which is often excessively discouraging and inconvenient to other parties, who may choose to have their own work done in their own way, and who, when they pay liberal wages for services required, might with some reason expect to find a servant instead of a master. But servant does not, I believe, belong to a republican vocabulary. I am content.

In executing, as I have done, some miles of underground draining, I should have utterly despaired of accomplishing it, but for the aid of some Irishmen and Scotchmen; and, I believe, I shall do no injustice by saying there is this difference between the two: For patient labor and the free expenditure of his strength in such cases, the Irishman cannot be exceeded; and his skill in the use of the spade, and the pickaxe, and the shovel, is unsurpassed. But he needs always direction; he only imitates, and follows a lead. The Scotchman goes himself. He is equally severe and laborious as the Irishman; but he has a judgment of his own to guide him, and he always brings that judgment to bear upon his work.

CI.—TILE AND PIPE DRAINING.

The thorough drainage of land now occupies the attention of the agricultural community in Great Britain more than any other branch of improvement connected with the soil. I know of none from which more important and beneficial results have been received, or may still be looked for. It will not be pretended that all soils equally demand it, or will be equally benefited by it; but, among the many instances which I have seen, scarcely any have failed to meet the expectations of those persons who have adopted this means of improvement. The drainage of land, as I have before remarked, has been a practice of long standing; but, as connected with subsoil ploughing, it must be considered as of modern date.

I have spoken already of various modes of forming drains. That of draining with tiles or pipes remains to be treated, and in several respects the experience of the last two or three years has effected extraordinary improvements, especially in the construction of the tiles or pipes, and in the reduction of the expense of the operation. The expense was at first of a character to render the improvement quite formidable; but from an outlay of £5, or in some cases even £10, it is now reduced, under favorable circumstances, to £2, or even less, and the great hinderance to its general adoption is removed.

1. **Improvements in Form of Draining-Pipes.**—Tiles were formerly made singly, and by hand. The clay was rolled out, and then pressed over a block into the shape of a horseshoe. In laying them in, it was deemed only necessary to lay them on a hard bottom of clay. But the running water constantly wore the bottom, and softened the clay; and the tile would sink into the clay, and the drain be rendered useless. The next improvement was to make them with feet; that is, to spread the bottom edge, on which they stood, outside, from a half of an inch to an inch in width,—thus,  —which served to prevent their sinking into the earth or clay upon which they rested. The next improvement was to construct a flat sole, to be laid in the bottom of the drain, which should be a little wider than the tile itself, and upon

which it should be carefully placed. This sort of tile is still used in many parts of the country; and it is universally advised, as the result of the best experience, wherever this horseshoe tile is used, that it should always be placed upon a sole or bottom. For this purpose, the sole might be formed and baked like the tile itself. Where slates are plenty and easy to be had, they answer well as a substitute for the clay tile. The next step in the improvement of the form of a drain tile was to bend it in the form of a pipe, bringing the edges almost together, but leaving a seam at the under part for the admission of the water, as it was then deemed indispensable for this object that it should be done. The last improvement is that of making a complete pipe, of such a diameter in the bore as is deemed necessary; and these are now made by machines, of which there are several of very ingenious construction, and some of which produce eight or eleven pipes at a single operation, of a uniform thickness and bore, and all cut to the same length. Different materials have been used for the formation of draining tiles; some have been a mixture of various substances, principally lime and sand, and called *concrete;* but perhaps no better material can be found than the best of brick clay; and this, when properly prepared and well baked, will be found to endure for a length of time as yet unascertained. The proper preparation of the clay requires that the stones should be picked out of it, and that it should be finely ground and pulverized. Some persons insist that it should be washed; but the best machines are so made as to avoid this necessity. The speed with which some of these machines are operated, is quite remarkable; it being asserted, on authority which may be relied upon, that Hatcher's machine, when worked by a man and three boys, will turn out nearly 11,000 pipe tiles, of one inch bore, in a day of ten hours, and so in proportion for pipes of a larger diameter. A machine invented by Mr. Scragg, of Calveley, Cheshire, "is equivalent," says Mr. Parkes, the engineer of the Royal Agricultural Society, "to the easy manufacture of more than 20,000 pipes of an inch bore per day of ten hours, and so on in proportion for other sizes. It is also worked," he adds, "at a less cost of labor, and with greater ease to the workmen, than any other machine with which I am acquainted." It must be admitted that this is a great advance in mechanical invention and improvement.

2. **Important Points in Draining.** — Some most important points in draining seem to have been but recently established. The first is, that water enters the drain from the bottom, rather than from the top; that is, its tendency is always to seek the lowest level. The second point, which seems well determined, is, that pipes of an inch bore are sufficient, when laid down at proper distances, for the rapid and effectual removal of any quantity of water from the land, which is the effect of rain upon the land. The third point is, that deep draining, though the drains be less frequent, is much more effectual than shallow draining, and that where drains of two feet deep have failed to run, or even drains of three feet have been ineffectual, drains of four feet on the same land have shown the presence of large quantities of water in the land, which otherwise would not have been removed. I have seen this completely demonstrated; and the testimonies on this subject are so multiplied within my own knowledge, that it may almost be affirmed that a single drain of four feet in depth will be more effectual in the drainage of a soil, than two drains of the same size laid at any depth less than three feet. The Duke of Portland, when I had the pleasure of examining his magnificent improvements at Welbeck Abbey, pointed out to me some land, which had been deemed sufficiently drained, and indeed much more deeply than was usual, but which, notwithstanding, continued to occasion rot to the sheep which were fed upon it; and the evil was not effectually removed until the drains were sunk to the depth of eight feet.

"Several respectable and intelligent farmers in Kent, who have laid drains very deeply in clays and stiff soils, assert that the flow from the deepest drains invariably commences and ceases sooner than from shallower drains after rain." This is a curious fact. That it should flow more copiously in such deep drains is to be expected, from the fact of a deep drain's affecting a larger extent of land than a shallow drain; but, as the gentleman who states this fact suggests, it is not so easy to account for the water falling upon the surface appearing in a drain four feet deep sooner than in one two feet deep. The fact, however, seems well established.

3. **Results and Experience in Pipe Draining.** — **Depth of Drains.** — I shall now proceed to state some facts, both in

regard to the depth of draining, and the sufficiency of pipes of a small bore for the perfect removal, in a short time, of all the water that falls upon the surface. I must premise, however, that these are but a few of those which have come within my own personal knowledge; but, these being stated with accuracy and exactness, I shall avail myself of them.

Mr. Hammond, of Penshurst, in Kent, states that he has drained ten acres with the round tiles, and that he is "quite satisfied that they act better than any other yet made, as they are not liable to be disturbed by moles or other vermin, which the other sorts admit, and can be laid with greater nicety in the drains than in any other shape. The effect of draining I have experienced for twenty years, and am quite satisfied that no expenditure on the land will make so good a return; as the effect of relieving the soil of the stagnant water to the depth of three feet instantly admits the atmosphere, and what before had been inert becomes active soil, and the root will penetrate it, and rain afterwards will pass through the soil into the drains with beneficial effects, where before it was injurious." *

Mr. Parkes, in his capital papers upon draining, says, "Several farmers have under-drained lands again, which were previously shallow-drained; and they agree in stating the beneficial result, in every case, to have equalled their expectation, and to have quickly repaid the cost." Mr. Spencer, of Wrotham, in Kent, has successively drained two feet, three feet, and four feet deep, and has invariably found an increasing fertility to result, in the same field, from the removal of the water to a progressively greater depth below the surface.

Mr. Arbuthnot gives the subjoined account of his success in laying land dry by drains sunk to the depth of four feet. Two pieces of grass land, containing about seven acres together, had been attempted to be drained, but without success, by the ordinary process of shallow drains. He then undertook to sink deep drains to the depth of four feet, at distances varying from 25 to 45 feet apart, and to lay pipes at the bottom of each drain. At the time the work was in progress, there was scarcely any rain; but upon its completion there were some heavy showers, and the effect of the four feet drains was soon established. The

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* Journal of the Royal Agricultural Society, vol. iv. part i. p. 47.

pipes in the furrows were 1½ inch in the bore; the pipes in the main drain were 3 inches in diameter. The rain rushed rapidly out of the new main drains, but none came out of the old shallow drains into the main drain. The lands soon became perfectly dry, which was very far from being the case under the shallow drains. Mr. Arbuthnot adds, "that he is so convinced of the effect of deep drainage, that, although the whole of the land which he occupies has been drained, partly with stones and partly with tiles, and, as was thought, to a tolerable depth, yet he designs to cross the old drains with deeper ones, in order to do all in his power to free the land from excess of water. Instead of using pipes of 1½ inch diameter, he would prefer the pipes of the cross drains running into the main drain to have been only 1 inch, being convinced that inch pipes would have answered every desired purpose."*

On a subject so curious and important as this, I deem it proper to quote from a letter from Mr. Hammond (to whose experience I have before referred) to Mr. Parkes. "I found," he says, "after the late rains, that a drain eight feet deep ran eight pints of water, in the same time that another three feet deep ran five pints, although placed at equal distances. The circumstances under which this experiment was made, as well as its indications, deserve particular notice. The site was the hop-ground before referred to, which had been under-drained thirty-five years since, to a depth varying from 24 to 30 inches; and though the drains were laid somewhat irregularly and imperfectly, they had been maintained in good action. Mr. Hammond, however, suspecting injury to be done still to the plants and the soil by bottom water, which he knew to stagnate below the old drains, again under-drained the piece in 1842, with inch pipes, in part to 3 feet deep, and in part to 4 feet in depth, the effect proving very beneficial. The old drains were left undisturbed, but thenceforth ceased running, the whole of the water passing below them to the new drains, as was to be expected. The distance between the new drains is 26 feet, their length 150 yards, the fall identical, the soil clay. The experiment was made on two drains adjoining each other, i. e., on the last of the series of the three feet, and on the first of the series of four feet drains. The sum of the flow from these two drains, at the time of the trial, was 975 pounds per hour, or at the rate of 19½ tons per acre in 24 hours; the proportionate discharge, therefore, was 12 tons by the four feet, and 7½ tons by the three feet drain. No springs affected the result. Hence we have two phenomena very satisfactorily disclosed — first, that the deepest drain received the most water; second, that it discharged the greatest quantity of water in a given time, the superficial area of supply being the same to both drains."

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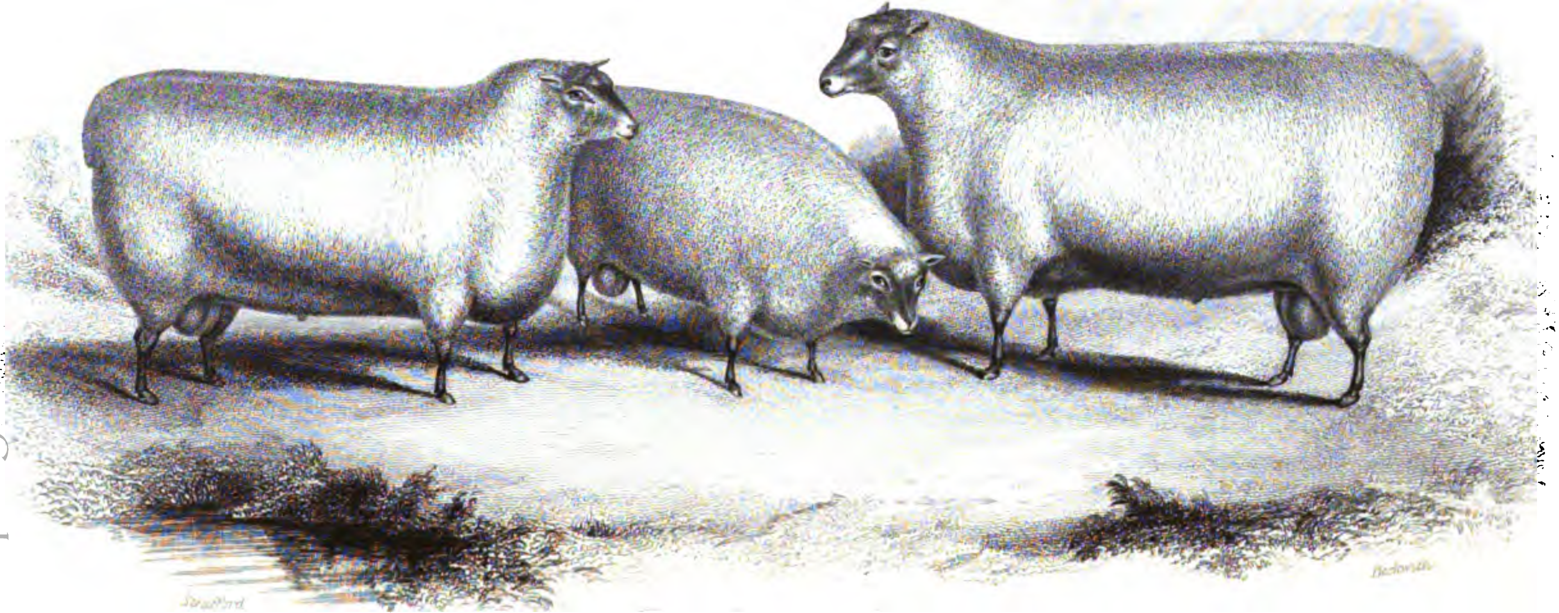
* Journal of the Royal Agricultural Society, vol. vi. part i. p. 130.



New Leicester Sheep

[illegible]

EUROPEAN AGRICULTURE.

SEVENTH REPORT.

CI. — TILE AND PIPE DRAINING. (*Continued.*)

On this subject Mr. Parkes continues his remarks: — "The phenomenon of a deep drain drawing water out of a soil from a greater distance than a shallower one, is consistent with the laws of hydraulics, and is corroborated by numberless observations on the action of wells, &c.; but the cause of the deeper drain receiving more water *in a given time*, is not so obvious. An opposite result, as to time, would rather be expected, from the fact of water, falling on the surface, having to permeate a greater mass of earth, both perpendicularly and horizontally, in order to reach the deep drain. A natural agricultural bed of porous earth resembles an artificial filter; and it is unquestionable that the greater the depth of matter composing such filter, the slower is the passage of water through it. In stiff loams and clays, however, but more particularly as regards the latter earth, the resemblance ceases, as these soils can permit free ingress and egress to rain water only after the establishment of that thorough net-work of cracks or fissures, which is occasioned in them by the shrinkage of the mass from the joint action of drains and superficial evaporation. These fissures seem to stand in the stead of porosity in such soils, and serve to conduct water to drains after it has trickled through the worked bed; it is possible, too, that, in deeply-drained clays of certain texture, the fissures may be wider or more numerous, in consequence of the contraction of a greater bulk of earth than when such soil is drained to a less depth." *

The fact to which this very able writer refers has its difficulties, as I have before remarked; but it is to be considered that, as a larger surface is drained by a deep than by a shallower drain, the streams through the pores or the fissures of the earth, which empty into it, are, of course, larger, and so acquire an increased momentum in their progress. If the descent of the water in the soil was altogether perpendicular, the drain nearer the surface would, of course, be reached first; but in a drain much more water must come diagonally or obliquely, than perpendicularly. The more land to be drained, the farther the water must flow; the farther the water has to flow, the greater the volume of stream which is collected; the larger the stream, the more its momentum and velocity will be increased. This supposes, however, that the passages are already opened and formed. In the case of the artificial filter referred to, the water, descending perpendicularly, would of course reach the bottom later than it would reach any higher portion; but, supposing the filter to have been so long made that the liquid poured upon it had formed various passages, it seems to me not improbable that the mass of water poured upon it would reach a central point at the bottom where it was to make its exit, or a basin in which it was to be collected, as soon as any small quantity would be collected, at a point somewhat higher up; and that the larger the size of the filter in this case, the more surface it covered, from the increased quantity, and the increased rapidity of flow given to the streams flowing to this point, the sooner it would become full, and even sooner than a point higher up, which would, of course, affect a proportionately less mass of surface to be drained.

4. SIZE OF PIPES. — There has been so much conversation and discussion on the size of pipes, and the efficiency or capacity of small pipes of only one inch bore, in effecting the drainage of land, that I know I shall agreeably tax the attention of my reader by quoting further from Mr. Parkes's excellent essay on this subject.

"It was on the 9th of November that I inspected the drainage

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* Journal of Royal Agricultural Society, vol. v. part 1, p. 150.

of Mr. Hammond's farm, recording the facts, that, after a rain of about twelve hours' duration, on the 7th, I found the drains, on the 9th, in a nine-acre piece, three feet deep, just dribbling, and those in a hop-ground adjoining, four feet deep, exhausted; Mr. Hammond having observed, previously to my arrival, that the greatest stream at the outfall of each drain amounted to about the half-bore of the inch pipe."

"The rain-gauge informs us that $\frac{48}{100}$ of an inch in depth of rain fell upon each square foot of surface in the observed time of twelve hours. This quantity is equivalent to $69\frac{1}{10}$ cubic inches, or $2\frac{1}{2}$ pounds, which, divided by twelve hours, gives little more than $\frac{2}{10}$ of a pound per square foot of surface per hour for the weight of the rain."

"The drains were 24 feet asunder, and each pipe a foot in length, so that each lineal foot had to receive the water falling on 24 square feet of surface, equal to 60 pounds, or 6 gallons; and as the time which this quantity occupied in descending through the soil and disappearing was about 48 hours, it results that $1\frac{1}{4}$ pounds, or one pint per hour, entered the drain through the crevice existing between each pair of pipes. Every one knows, without having recourse to strict experiment, how very small a hole will let a pint of water pass through it in an hour, being only one third of an ounce per minute, or twice the contents of a lady's thimble."

"The weight of rain, per acre, which fell during the 12 hours, amounted to 108,900 pounds, or $48\frac{6}{10}$ tons, which on the whole piece of nine acres, is equal to $437\frac{4}{10}$ tons; and each drain discharged 19 tons, equal to about $\frac{4}{10}$ of a ton per hour, on the mean of 48 hours; but when the flow was at the greatest, I find that each drain must have discharged at the rate of five times this quantity per hour, which affords proof of the faculty of the pipes to receive and carry off a fall of rain equal to $2\frac{1}{2}$ inches in 12 hours, instead of half an inch — a fall which is quite unknown in this climate. Half an inch of rain in twelve hours is a very heavy rain. I learn from Mr. Dickinson that his rain-gauge has never indicated so great a fall as $1\frac{1}{2}$ inch in 24 hours, and from Dr. Ick, the curator of the Birmingham Philosophical Institution, that only on five occasions has the rain there exceeded one inch in 24 hours, during the same period of eight years. We may, therefore, consider the fact of the sufficiency of inch-bore pipes for agricultural drainage to be fully demonstrated, both by experience and experiment."

5. THE PHILOSOPHY OF DRAINING. — The drainage of land is of such vast importance, that, although my remarks on the subject have been much extended, I may safely longer claim the indulgence of my reader. It may be safely laid down as an established principle, that, in order to the successful cultivation of the soil, the cultivator must have, as far as it can be acquired, the command of the water by which that soil is affected. I have already said that wetness may be ascribed to two causes; the first, arising from what are called *permanent springs* in the soil, which, of course, are more or less affected by the rain which falls, but whose origin may be sometimes traced to a considerable distance from the ground, which is covered or saturated by them; and secondly, from rain falling directly upon the field. The former can be remedied only by cutting off the spring or the channel in which its waters flow. The latter evil can be remedied only by a system of drainage, so frequent and so formed and laid, as to convey the water away in the shortest possible time. I call it an evil; but, in the main, the rain which falls is, of course, an immense good — a great and powerful instrument of vegetation, without which no vegetation could prosper, or even survive. It becomes an evil only when it becomes stagnant. The effects of stagnant water in land are destructive to vegetation; or rather, under certain conditions, it may even produce a greater luxuriance of vegetation, but the plants produced in a very wet soil are unpalatable, innutritious, and insubstantial. Animals fed upon them always lose condition, and the manure of animals so fed is almost worthless. I saw this strikingly illustrated in the magnificent park of the Duke of Bedford, at Woburn Abbey. Here there were many spots where the grass was luxuriant and abundant, on account of their excessive dampness, and which were entirely neglected both by the sheep and the deer; but wherever these places, once wet, had been thoroughly drained, they became the favorite resorts of the animals, and were fed as closely as possible. I have witnessed similar results in many other cases.

Water is an element in the food of plants, composing, in some instances, as in the turnip and potato, a large proportion of their substance; the former, it is stated, containing nearly 90 per cent., the latter varying from 70 to 80 per cent. Water, filtering through a soil, opens its pores to the admission of air, which is most essential to the growth of the plant, or perhaps, more properly speaking, to the fertility of the soil. Humboldt observed that argillaceous soils and humus deprived the air of its oxygen. He satisfactorily ascertained that earth taken from the galleries of mines at Salzburg only became fertile after having been exposed to the atmosphere for a considerable length of time. These observations established the necessity of the presence of oxygen in the interstices of the soil, or, as he then said, and as may still be maintained, the utility of a previous oxidation of the soil. All our agricultural facts, indeed, confirm this view of the necessity of air in the interstices of the soil that is destined for the growth of vegetables. When, by ploughing very deeply, for example, we bring up a portion of the subsoil into the arable layer, in order to increase its thickness, we always lessen the fertility of the ground for a time: in spite of the action of manures, and of any treatment we may adopt, a certain time must elapse before the subsoil can produce an advantageous effect; it is absolutely necessary that it have been exposed to the atmospheric influences; and it is then only that deep ploughing, which gives the arable layer a greater thickness, pays completely for the expense it has occasioned.*

Water contributes, in the next place, when filtering gradually through the soil, to dissolve the manures, and prepare them to assist in the growth of the plants — in some cases, for the elements of these manures to be taken up by the plants. But water in too great abundance destroys these manures, and carries them away. Rain water, falling upon the surface, when the temperature of the air is higher than that of the soil, contributes to increase this temperature of the soil. Water, when stagnant in a soil, diminishes its temperature. The extreme wetness of a soil renders it difficult to be worked; impedes the sowing or planting; often destroys the seed and the crop; occasions it to become poached or inaccessible to animals; and in many other ways may be said to make the cultivation of such soils hopeless.

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* Boussingault, p. 286.

The rain water which falls upon land may be detained by two circumstances — the first by the impervious nature of the upper soil, which may be an adhesive and strong clay, through which the rain cannot percolate; the second, by an impervious or indurated subsoil, either of clay or of hard pan, which holds fast the water when it reaches it, and consequently the upper portions become saturated or flooded. In respect to the former, the adhesive clay, though there have been some failures, yet there are many remarkable instances, where, by a system of under-draining and subsoil-ploughing, the hardest soils have been opened and rendered comparatively dry and friable. When a ditch or drain has been dug, the tenacity of the neighboring soil has been loosened, and the drying of the soil in the hot sun of summer has, under such circumstances, caused it to crack in various directions, and, these fissures being once opened, channels for the trickling of water have been formed; others have followed from contiguity, and these adhesive soils, by a course of cultivation, have been loosened and reduced to a condition of unlooked-for dryness and fineness. Where the wetness of the soil has been occasioned by a hard and impervious subsoil, this evil has found no other effectual remedy than in deep draining, and the thorough breaking up of this hard layer by the subsoil-plough. The stratum below is often found pervious to the water, which makes for itself a ready exit, when it once reaches it. Some persons are of opinion that, if it were possible to prevent it, it would not be desirable to draw off the water beyond a depth of from four to five feet, — vegetation ordinarily not extending beyond this, — thinking that, in time of drought, the upper surface might be benefited by the evaporation of the water at this depth, or its ascent by the process of capillary attraction. It is useless to speculate in this case, as such a matter must be almost wholly beyond our arrangement or control. I ought to add that, where this adhesive soil is once loosened, its porosity — if I may borrow a hard word — is often much assisted by the common earth worms, who penetrate it in various directions, and, directed by natural instinct, aim especially at the drains or places where the water is found. Thus it is that we are often served by our most humble friends, and in circumstances where we never think of recognizing the obligation.

6. MAGNIFICENT AGRICULTURAL IMPROVEMENTS, AND THEIR MORAL RESULTS. — These may be considered as the general principles of draining; and, as I have before remarked, it must be placed almost at the head of British agricultural improvements. Much as it has already done in connection with subsoil-ploughing, it may be said only to have begun its work; and it seems destined to double, in many cases to quadruple, the agricultural products of the kingdom. The scale on which it has been carried on, by some distinguished improvers, may well excite surprise on the other side of the water. The Duke of Portland, it is stated, had some time since completed more than 7000 miles of drainage on his estates, although much of this was done before the system of subsoil-ploughing was introduced. The Duke of Bedford informed me that he made about 200 miles of drainage on his estates in a year, and about 50 miles in his Park grounds. This was all executed in the most excellent manner.* Lord Hatherton at Teddesley Park, whose

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* The Duke of Bedford was kind enough to give me, while enjoying the unaffected and princely hospitalities of Woburn Abbey, an account of his draining operations for three years, which I shall here subjoin. It will interest an intelligent reader, by showing him the extent to which agricultural improvements are carried in this country; and it will illustrate another point, to which I have more than once referred, the accuracy with which, on such estates, the farming accounts are kept — a matter which cannot be too much insisted on.

"*An Account of Draining on the Duke of Bedford's Bedfordshire Estates, in the Years* 1841, 1842, 1843, *and* 1844.

	Acres.	Tiles.	Cost.			Average Cost per Acre.		
"In winter of 1841 and 1842: —			£	*s.*	*d.*	£	*s.*	*d.*
Woburn Park and Grounds	90	254,950	864	5	7	9	12	0
Woburn District	90	240,300	648	17	5	7	4	0
Bedford District	203	392,760	1095	8	5	5	1	0
"In winter of 1842 and 1843: —								
Woburn Park and Grounds	71	194,505	612	4	0	8	12	0
Woburn District	277	625,750	1587	14	7	5	15	0
Bedford District	232	492,845	1409	0	9	6	1	0
"In winter of 1843 and 1844: —								
Woburn Park and Grounds	100	180,000	636	0	5	6	12	0
Woburn District	243	494,150	1411	18	1	5	16	0
Bedford District	228	430,300	1391	1	1	6	0	0

"*Note.* — The greater cost per acre of draining in the Park than upon the admirably improved estate I have had the pleasure of repeatedly visiting, had, some years since, completed the drainage of more than 467 acres, at an expense of £1508 17s. 4d.; and had increased the rental of his land, by these operations, to the amount of £435 2s. 4d. per year, or at the rate of 29 per cent. upon the capital expended. The main drains here were laid about three feet deep, with tiles about five inches wide by twelve inches long. The branch drains are about two feet six inches deep, and are laid with tiles about four inches wide by twelve inches long. In some of the valleys, the substratum is of a loose mixture of sand and gravel; and in those places it was found necessary to adopt drains varying from five to eight feet deep, which pour forth large bodies of water, both in summer and winter.

It may be said, such is the rapidity with which agricultural improvement is advancing in this country, that a great revolution has been effected in the system of draining since these splendid improvements were accomplished; and that draining fully as efficient as the above is now reduced to one half of the expense.

The country abounds with examples of agricultural improvement on the part of individual proprietors, if not upon so extensive a scale, yet, in proportion to the ability and means, quite as enterprising and spirited. It is truly delightful to witness such an application of wealth; and the benevolent mind is never more disposed to envy the possession of power than when it is thus beneficently exerted. The erection of magnificent houses or palaces in a city, far beyond one's needs, I am not disposed to deny, does good, as it creates a demand for ingenious, industrious, and, to a degree, useful labor, and circulates a large amount of

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estate, arises from the carriage of tiles and soles being included in the former, which in the latter is done by the tenants without charge.

"The saving in Park draining, in 1842 and 1843, was in labor chiefly, that being lower in 1842 and 1843 than in 1841 and 1842.

"The additional saving in 1843 and 1844 was, by putting the drains one yard farther apart, viz., 6½ yards, instead of 5½, as in former years. The depth of the drains was increased, and the labor also, but the value of the tiles saved in quantity was considerably more than the increase of labor.

"The difference in cost of draining, between one part of the estate and another, is occasioned by the various sizes of the lands, as, in high-ridged and crooked lands, the drains follow the water furrows, at whatever distance they may be."

wealth where it is needed. There is a pleasure, likewise, in contemplating the skill and architectural taste displayed in their structure, the beauty of their arrangements, and the luxury and splendor with which they are adorned and furnished. But often they are mere monuments of vanity and display; they are a serious drawback upon the resources of the proprietor; they are much beyond his wants and convenience; they involve a necessity of a style of living which sometimes brings with it as much vexation as pleasure; and the wealth which is expended upon them is locked up, to a great extent, in a profitless disuse, or otherwise may be considered, as far as it exceeds the necessities, or convenience, or uses of the proprietor, as irrecoverably thrown away.

But how different are the results of the application of wealth to the purposes of agricultural improvement; in converting land which is waste into that which is productive; in the employment of the poor in useful and healthful labor; in increasing the means of human and brute subsistence; in advancing the real wealth of the community; in the actual creation of wealth without loss or injury to any one; in making improvements, which have in themselves a reduplicative energy, so that the more improvement is made, the more the power of improving is extended and enlarged; in exhibiting an example of skill and success which excites no ill-will, because it injures no man's interest, but is every where beneficial, and prompts to a wholesome emulation; which leaves behind it not traces drawn in the sand, to be obliterated by every wave which time rolls upon the shore, but which are to endure for generations and centuries to come; and which, in truth, constitutes one of the most honorable and enduring monuments, which a reasonable and well-disciplined ambition of posthumous reputation and fame can desire or seek after!

7. SOILS TO BE DRAINED. — In reviewing this important subject of the drainage of land, — one, certainly, of the most important connected with the art of husbandry, — I deem it best to recapitulate some points, which have been partially noticed, and are to be deemed established.

The removal of water from the land is, then, in all cases, indispensable to a successful cultivation. Where it proceeds from permanent springs, they must either be cut off or led away by a drain which shall directly reach them. There are very few lands which would not be benefited by draining. Wherever a spot is discovered in a field, where the water is accustomed to lodge, or which, from the coarseness or character of the herbage growing upon it, indicates the presence of water, we may feel sure that there the operations of draining are required. In the next place, it is desirable that the wetness arising from rain should be removed as soon as practicable. All the advantage which plants derive from rain are obtained from its immediate passage through the soil. Whenever its passage is arrested, and the water becomes stagnant, its presence is injurious, excepting to plants which are, like rice, for example, of an aquatic, or, as it may be termed, an amphibious character.

That soils of a light and sandy character are benefited by draining, I have had the fullest demonstration, and shall presently show. That soils of a most retentive and adhesive character have been greatly improved by it, seems to be established in many cases, though there are instances of failure in this respect; and an intelligent and spirited agriculturist in Yorkshire, with whom I have the pleasure of an acquaintance, has proposed that analytical experiments should be made, to determine what proportion of aluminous matter in a soil should discourage any attempts at improvement, by draining and subsoiling. Perfect success has followed the operation where the amount of clay or alumine has been as great as 24 per cent.; and failures have occurred, where the proportion has been 43 per cent., which induces the conclusion with him, that the boundary must lie somewhere between these two points. This, he thinks, experiment alone can decide. It must not be overlooked, however, that other circumstances besides the actual composition of the soil, may have effected the results. Mr. Hammond, before quoted, has been successful in draining heavy and adhesive soils, where, after the drains have been opened, and the pipes laid and but slightly covered, the frost has had an opportunity of operating upon the land, and occasioned fissures, which have been converted into permanent pores or channels for the water falling upon such land to reach the drains. There is always some encouragement in the simple fact, that one drop of water is sure, in its natural course, to follow another. There are, however, undoubtedly, some soils, where, from their impervious character, draining would be almost hopeless. It is difficult to pronounce beforehand what soils come under this description. It is certain that many soils, which were considered beyond the reach of this species of improvement, have been subjected to it with great and permanent advantage. In many cases, the character of the soil, whether suitable or unsuitable for drainage, might be easily ascertained by sinking a hole of the depth to which it is proposed to drain, and, securing it from the access of rain, or of water running upon the surface, ascertain whether any water would filter into it.

8. **Association for Drainage.** — The drainage of land upon the most improved principles and method, may be considered in England as a branch of engineering, to the successful application of which both science and much practice and experience are requisite. For an individual to undertake it upon any extensive scale, without sufficient knowledge and skill, would be likely to terminate in disappointment and loss. It would seem as though no better plan could be adopted than that which has been recently undertaken, viz., the organization, with an ample capital, of a draining association. This company, under the name of the West of England and South Wales Land Draining Company, propose to establish, in different and convenient parts of the country, where the clay is abundant and suitable, tileries for the manufacture of pipe tiles; they mean to secure to themselves always the services of accomplished and practical engineers, and, having proper tools and experienced workmen, they will undertake the effectual drainage of whole farms, guarantying that the work shall be executed in a correct and perfect manner; and in this way at a great saving of trouble, and at a great deal less expense than it could be effected by individual effort and enterprise. It is difficult to conceive of an arrangement from which, if skilfully and liberally managed, more advantages may result. An extensive and thorough system of drainage will, beyond all question, effect for England the greatest and best improvement, in an agricultural view, which can possibly be looked for. "The effect produced on the crops of close, retentive soils, after they have been perfectly drained and subsoil-ploughed," says Mr. Morton, "is most astonishing. The prod-

uce is so much increased, that it will, in many instances, pay the expenses in a year or two; and wet soils, which seemed to be strong clay when wet, become friable, and even light, when completely subsoil-drained, are easily cultivated, and light enough for producing turnips to be fed off with sheep. Complete or perfect drainage is the foundation of all improvements in husbandry; it should, therefore, be the first step which we take in attempting to improve or ameliorate the soil."

9. THE PROCESS OF DRAINING. — In looking at a field or piece of land, which is proposed to be drained, the first thing to be ascertained is, what fall can be had for removing the water. A fall of one in two hundred is stated, by practical men, to be the extreme on one side; but it is desirable to get, if possible, one in a hundred. With such an inclination, the drains are more likely to be kept free from sediment. The next step to be taken is, to lay out and form a main ditch or drain, into which all the small drains shall empty themselves, and the water be carried off. This, of course, must be in the lower part of the land, and it is generally advised to let it remain open, that the mouths of the small drains may be observed and watched. Where left open, as at the model farm of Lord Ducie, there the inclination of the sides is so easy that they are cultivated to the water's edge. It is advised, in other cases, to let the side drains empty into a common main drain, which is to be covered; and this main drain is to empty itself into an open ditch. The principal reason assigned for having all the underground parallel drains empty themselves into the main, and through that into the ditch, instead of each emptying itself into the ditch, is, that while, in the latter case, a hundred mouths would require to be kept open and clear of rubbish, in the former only one has to be attended to; and also that, during the summer months, some of the parallel drains would become dry, and allow the entrance of moles and rats, which would soon stop them up; but that the quantity of water which always issues from a main drain would forbid their entrance, and thus hinder them from injuring it or the others.* Where the bottom of the drain, however, is formed with broken stones, there is no danger from this circumstance; and where the

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* Morton.

pipe drains of only one inch bore are used, they do not admit of the entrance of vermin. On Mr. Smith's. plan, however, the main drains are covered as well as the side drains, and the entrance or outlet of the main drain may be protected by an iron grating, or a foot or two of broken stone laid down at the end. It is advised that the main drain should be sunk six inches lower than the side drains; but where pipes are used, the side drains may enter directly into the main drains, the pipes being made with a hole in the side, for this express purpose. It has been found quite effectual, in some cases, to lay two pipes for a main drain, side by side; but it would seem most desirable to have a pipe of a large bore for the main drain, and of a sufficient size to receive all the water which should be emptied into it from the side drains. Such pipes, at Mr. Stirling's, near Falkirk, were of a very large bore, and made in three parts, so as exactly to fit each other when brought together. The advantage of a concave or circular bottom for the water to flow in, in preference to a flat sole, must be obvious at first thought. Tiles have been constructed with a circular bottom, like a horse-shoe set upon its front edge, and a flat cover to rest upon it; but I can see no advantage which this has over a pipe; unless it might be that, by the removal of the cover, the seat of any obstruction might be ascertained without lifting the whole.

It is often found necessary to make what are called *submain drains*, which of course communicate with the main drain. This must depend upon the nature of the ground, and where these submains are made on the side of a hill, they are best made obliquely, crossing the small drains diagonally, and thus giving an impulse to the water received into them. It is advised, in all cases, to make the parallel drains, which connect with the main or the submain, straight, whether running on level land, or on a side hill; and it is deemed best that no small or parallel drain should ever exceed two hundred yards in length, without emptying into a main or a submain drain. The distance at which the drains should be placed apart may vary with the nature of the soil, from a rod to forty or sixty feet. It may be interesting to know the length of drainage, or of pipe, which may be required in an acre, at the different distances which are customarily adopted. I subjoin, therefore, the following table: —

Distance between Drains.	Length of Drains in Furlongs.	Feet of Pipes.
66	1	660
44	1½	990
33	2	1320
22	3	1980
16½	4	2640

"On the heavy lands of Suffolk, and the adjoining counties," says one farmer, "under-draining at a distance of 16½ feet, and at a depth of 26 or 30 inches, is as much a matter of routine as hedging and ditching." This depth would now be deemed quite insufficient.

The mode of covering drains is various. Where the drains are filled with broken stones, it is advised to lay upon the top of the stones an inverted sod, and then return the dirt which has been taken out. Where a pipe or tile and sole are used, the same advice may be given. In adhesive or clayey soils, it is deemed quite objectionable to return the clay, and ram it in closely upon the pipe. It has been deemed important, by some persons, that alternate pipes of a large and a small bore should be used, so that the small pipes may enter the larger ones, and that there should be no interruption of continuity between them. In some cases, rings of clay have been formed, into which the ends of the two pipes might enter, so as to close the interstice, and retain the pipes upon a level. This is not, however, deemed necessary. Where the bottom is hard, and the pipes carefully placed, there is no danger, afterwards, of their getting, if the term may be allowed, misfitted; in cases where the bottom is sandy or loose, more pains must be taken to prevent this, which is easily done by an experienced and careful drainer.

10. Examples of Drainage in Ireland.—I have now, I believe, enumerated the principal points to be observed in draining a piece of land according to the most improved system. With a view the better to illustrate this important subject, I subjoin a plan of the drainage of a farm in Ireland, belonging to Messrs. Andrews, of Comber, county Down, (see p. 120,) together

with their general account of the process. This was executed exactly according to the directions of Mr. Smith, of Deanston, with tiles, and a foot of broken stone laid in upon them; and before the pipe tiles had received so much of the public approbation as has since been deservedly bestowed upon them.

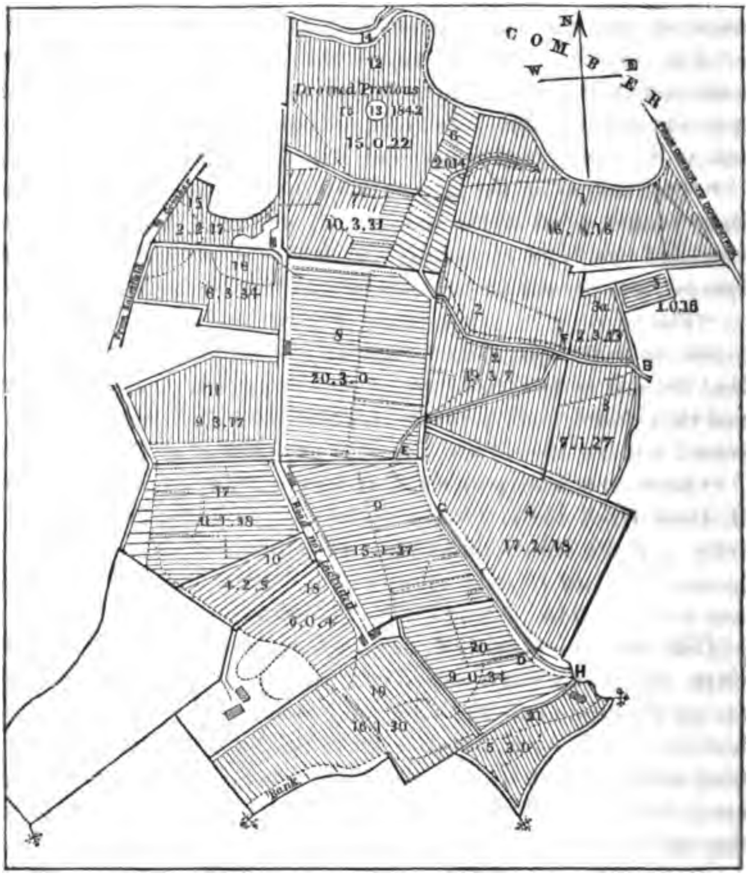
"The accompanying map represents that portion of the lands in the townland of Carnesure, which has been thorough-drained up to the present time. Another part of the farm, in the townland of Comber, containing 19½ acres, was drained in 1841. The specification on the map exhibits the quantities drained in the respective years 1841, 1842, 1843, and 1844, each of which comprised the portion which the course of cropping enabled them to manure, and to place under green crops in the succeeding year.

"In the year 1843, they completed the thorough-draining of 58 A. 3 R. 7 P. statute measure, by the execution of 7172 statute perches parallel, 793 perches submain, and 128 perches main drains; and in 1844, 58 A. 1 R. 37 P., by 7720 perches parallel, 781 submain, and 20 perches of main drains, being, in the years 1843 and 1844, 117 A. 1 R. 4 P. statute measure, viz. —

14,892 perches statute of parallel drains.
1,574 " " " submain "
148 " " " main "

"The mode of execution has been precisely the same as that which Mr. Smith characterized as 'most thoroughly following out the Deanston system.' In the whole of the land drained, there is not one open channel for water; all the water passes away under ground, and the wheat seed on the potato land has this year been covered with the grubber, without any ploughing, after the removal of the potatoes, leaving the land perfectly flat, and without a furrow, as recommended by Mr. Smith, so that every stalk of grain will benefit equally from both the soil and the atmosphere; and during the late rains, even on sloping ground, not a particle of the fine soil has been washed from the land, while, in the undrained lands around, the roads and ditches are filled with the fine deposits from the streams of water which have rolled down the furrows, and the rivers are red with the still finer matter which they are hurrying to the bottom of the sea. This advantage is attained without any attendant evil; they look to the total abolition of every water-furrow from the fields."

Plan of the Thorough Draining on Part of the Townland of Carnesure, the Property of Messrs. Andrews, of Comber, County Down, to which the Gold Medal of the Society was awarded for 1844.



REFERENCE.

	A.	R.	P.	Length of Main Drains.	Length of Sub-main Drains.	Length of Parallel Drains.
Ground drained in 1841, contains	15	0	22	— perches.	154 perches.	2018 perches.
Do.... do... in 1842,.. do...	70	1	14	148.. do...	715.. do..	8370.. do.
Do.... do... in 1843,.. do...	58	3	7	128.. do...	793.. do..	7172.. do.
Do.... do... in 1844... do...	58	1	37	20.. do...	781.. do..	7720.. do.
	202	3	0	296	2443	25280

Note.—Main Drains are shown thus, ══════════

Submain Drains,...... thus, - - - - - - - - - -

Parallel Drains,....... thus, ≡≡≡≡≡≡≡≡≡≡

"The parallel drains are at least 30 inches deep, with 12 inches of small stones; the submains are 6 inches deeper, laid with slates and tiles, and filled with stones to the level of the parallel drains, and both are carefully levelled, turfed, and firmly tramped; and the mains, flagged in the bottom, built with dry masonry, and covered with coarse flags, are placed at depths, and constructed of dimensions, in all cases exceeding what Mr. Smith has considered sufficient to carry off the entire water from the submains, during and subsequently to the heaviest falls of rain.

"The soil, as stated in last Report, rests on the grauwacke slate formation, and the subsoil, as described by Mr. Smith, 'consists chiefly of a clay drift, with gravel stones thickly interspersed, and occasional boulders of considerable size.'

"The work of thorough draining of every year has been followed up in the succeeding year by subsoil-ploughing. All the land drained in 1843 was subsoiled and in green crops in 1844, and that drained in 1844 has been undergoing the process of subsoiling, which will soon be completed."

"As regards the profits to be derived from capital expended in thorough-draining," these gentlemen say, "our experience fully realizes our largest expectations. In green crops the increased return is most conspicuous. In undrained land in a wet year, potatoes and turnips have ever proved wretched crops; and all attempts to clean the ground have invariably failed. In 1840, our crop of potatoes on wet land did not exceed 200 bushels per Cunningham acre; this year we ascertained, by actually weighing, on the weigh-bridge, the entire crop of potatoes, of the kind called *cups*, from field No. 4, containing above 17 statute acres, (excluding the head lands from the calculation, both as to crop and measurement,) that the produce was,

	Tons.	Cwt.
Per statute acre, 472 bushels, of 56 lbs. each, or	11	16
Per Cunningham or Scotch acre, 610	15	5
Per Irish acre, 766	19	3

"And on field No. 7, several trials were made of drills dug the length of the field, the kinds being lumpers and other coarse varieties; and the produce was at least one sixth greater than that of the cups.

"This we regard as very great produce, and the difference between such a crop and the starved produce of 1840, on land equally good, would more than doubly repay the entire cost in one year. On the average of wet years, we think it may fairly be reckoned, that the increased return of one green crop would amply repay the costs of draining. Of the increased return from white crops we cannot yet speak so definitely; but the crops on our drained land have been very luxuriant and satisfactory, and the weight of the wheat which was threshed for seed in November this year, was 63¾ lbs. per bushel, which exceeds what we have ever before experienced, in the best years, on our farm.

"The clover and grass seeds have all succeeded much better than we have been accustomed to for many years, and are now luxuriant, and thickly planted on lands which have for some years appeared clover sick; probably owing to the treasures of the subsoil being laid open to them, and possibly also to the higher temperature of the dry soil preventing the injury by frost to the crowns of the clover plants, to which some observers have attributed the failure of clover.

"That the subsoil is so laid open, is abundantly proved by the roots striking downwards, as far as the depth of the drains admits air to the subsoil; for we have extracted from our drained land the tap-roots of Swedish turnips more than two feet in length, Nature having doubtless taught them to search in the subsoil for that inorganic food, of which the upper soil, by long cropping, had been largely exhausted, but which subsoil they would not have dared to penetrate, had it been saturated with stagnant moisture, to the exclusion of atmospheric air.

"We do not feel it necessary to enter into any further details or observations; we can confidently recommend all who may read this Report to embark in the same course of improvement, which we at first commenced with caution, and have pursued and extended with increasing confidence and satisfaction as we proceeded. The expenditure has been serious; but we entertain no doubt of an ample remuneration."

To this I shall subjoin the statements of another eminent improver in Ireland, who has very successfully drained land to a large extent.

"The character of the land drained is mostly an adhesive clay, and the subsoil of a bluish-yellow clay, with a mixture of large stones, forming a very retentive and impervious mass.

The rock, which is of the granwacke slate, comes near the surface, and in some instances prevented the drains being cut as deep as might have been wished. The average height of the land drained is about 200 feet above the level of the sea, with a western aspect. The higher portion of it, previous to being drained, was *wet*, *shallow*, and sterile, and the lower part a heavy, stiff clay, which, in unfavorable seasons, was almost impossible to prepare for drilled crops. The effect of the drainage on all this land is very conspicuous, particularly on 140 acres which have been subsoiled. The land is now a deep and free soil, producing excellent crops of potatoes, turnips, and carrots, when previously it was quite unsuited to drilled crops.

"I would, however, from any conclusions I can draw from experience, beg to recommend, in ordinary cases, where the rock does not interfere, and where sufficient fall can be obtained, that the drains should be cut at least *three feet deep*, and that tiles and soles, or pipe-tiles, should be used in preference to stones, both as to efficiency, and above all to permanency.

"I am fully satisfied, in the greater number of instances, that much expense may be spared in materials for filling, by increasing the distance between, and adding to the depth of the drains. One great advantage in favor of the deep drains is, that they are calculated to be more permanent, and that, while in wet weather they discharge fully as much water, they continue in operation a much longer time, and in many instances continue to give out water for weeks after the shallow drains have ceased to discharge upon similar soils.

"The following is a description of the manner in which the drains at Ballyleidy have been executed: The submains are laid off on a considerable declivity, and cut six inches deeper than the parallel drains, with a slate and a large tile laid in the bottom of each, with stones carefully coupled over the tiles, and six inches of broken stones placed over all, then neatly turfed. Iron grates are built in at the mouths, where these submains discharge, so as effectually to prevent the entrance of any kind of vermin. I am now satisfied that the most permanent submains are two tiles reversed, forming a pipe, and thus confining the water so as to give it force and pressure, to clear away all obstructions.

"The parallel drains were neatly cut, and, where stones were used, filled 13 inches deep, the stones regularly levelled, which were all screened, and broken, to pass through a three-inch ring; then covered with a thin sod, which was well tramped down.

"When the tiles and stones were both used, about 25 tons of well-broken stones were put over the tiles to the acre, and the drains well sodded.

"It was also found necessary to build a large main drain for conveying the water from about four hundred acres, through a large tract of ground, which added considerably to the expense.

"In May, 1844, preparation for turnips was commenced upon it, and all parties previously acquainted with it were astonished at the change. It had become deep, free, and open, one ploughing and harrowing being quite sufficient to prepare it for drilling. Fifty barrels of lime to the acre was applied, after the first stroke of the harrow, and then well harrowed in with a heavy iron harrow, mixing it minutely with the soil, to the depth of 5 or 6 inches. It was then drilled and sown with Swedish turnips on the 6th and 7th of June — part being manured with 4 cwt. of guano to the acre, and part with 2 cwt. of guano and 12 bushels of crushed bones: the result has been a superior crop — the medal given by the Royal Agricultural Society to local societies, for the best cultivated 5 acres of turnips, having been awarded by the Bangor Farming Society for this crop. I have every reason to believe that all kinds of crops usually grown in this neighborhood may in future be grown on it successfully; that they may be sown or planted at times, *particularly after heavy rains*, which would have been impossible before draining, and that in all cases, with the same manure and labor, there will be fully one third of an increase in the crop."

This gentleman proceeds with some observations, which are quite worth recording.

"It may be proper to remark why it is that I recommend drains to be made deeper and farther apart than those which have been executed at Ballyleidy; and why I prefer tiles, while a large portion of the drains at Ballyleidy have been made with stones.

"In the first case, it is from the experience obtained by a careful examination of the effects produced by drains of different depths, that I have become convinced of the superiority of deep over shallow drains. With respect to stones, it was a matter of necessity using them here, as I have been long satisfied that tiles or pipes are preferable. It was only the difficulty of obtaining tiles in time at a reasonable price, which prevented them being used in all cases. I may also observe, that I have in many instances put stones over tiles, but now believe that even in the stiffest clay this is unnecessary, the drains which have been made with tiles alone being equally efficacious. The tiles, where stones are not put over them, are less liable to be injured or broken, and of course calculated to be more *permanent* — an object which, in such an important improvement, should never be lost sight of."

CII. — SUBSOIL-PLOUGHING CONNECTED WITH THOROUGH-DRAINING.

I have given these general examples of thorough-draining, which might be multiplied, under my own observation, to a very great extent, and have to add that this improvement is preparatory to subsoil-ploughing, and intimately connected with it.

I have already fully described the nature of subsoil-ploughing. Trench-ploughing is sometimes mentioned. By trench-ploughing, the under soil is brought to the surface, and, in fact, it is no other than deep ploughing, and is created by passing a second time in the ploughed furrow. In subsoiling, the lower stratum is stirred and broken, but not inverted.

Subsoil-ploughing is never to be recommended without first draining, unless in cases where the lower soil is extremely loose and porous, so that the water can pass immediately off. The late Mr. Rham, a distinguished farmer, attempted this upon an adhesive soil, but found that, to use his own expression, it held water as a sponge, and became quite unmanageable, until he proceeded completely to thorough-drain it with tiles. "Until there is an escape for the water through the subsoil, any opening of it but provides a greater space for holding water, and will rather tend to injure than improve the soil."

1. **Results of Subsoiling and Draining.** — The improvements effected by the process of thorough-draining and subsoiling have been most remarkable. The manager of the farm of Sir Robert Peel says, "that he can confidently state, that the crop of turnips, after the above treatment, was four times the quantity in weight ever produced in the same field at any previous time." Mr. Smith says, in an early treatise on this subject, that which has been fully confirmed by subsequent experience, that, "when land has been thoroughly drained, deeply wrought, and well manured, the most unpromising, sterile soil becomes a deep, rich loam, rivalling in fertility the best natural land in the country, and from being fitted for raising only scanty crops of common oats, will bear good crops of from 32 to 48 bushels of wheat, 30 to 40 bushels of beans, 40 to 60 bushels of barley, and from 48 to 70 bushels of early oats, per statute acre, besides potatoes, turnips, mangel-wurzel, and carrot, as green crops, and which all good agriculturists know are the abundant producers of the best manure. It is hardly possible to estimate all the advantages of dry and deep land. Every operation in husbandry is thereby facilitated and cheapened; less seed and less manure produce a full effect; the chances of a good and early preparation for sowing are greatly increased — a matter of great importance in a precarious climate; and there can be no doubt that even the climate itself will be much improved by the general prevalence of dry land."

Mr. Smith further remarks upon the improvement of the soil upon his own highly-cultivated and conditioned farm at Doune, which I had the great pleasure of inspecting, that, "when he commenced these operations upon his own farm, on a part of it he had not more than from four to four and a half inches of surface soil; but having applied the system of thorough draining to it, and used the subsoil-plough, he can now turn up more than sixteen inches of good soil, and it is not more than twenty years since he began."

2. **Failures in Subsoiling in adhesive and heavy Soils.** — I cannot say that this process within my observation has been without failures. Mr. Sworfield, the intelligent manager of the beautiful estate at Chatsworth, informed me that it had not been

successful with him. My respected friend, Mr. Spencer, on his well-cultivated farm at Bransley, in Lincolnshire, complained of its being ineffectual, from the soil being too adhesive and heavy, and soon running together, and becoming as compact as before breaking up. Mr. Black, in Yorkshire, the steward of the Earl of Zetland, says that one of his subsoiled fields produced thirty-five, and the other twenty-seven and a half bushels of wheat per acre; the field that produced the greatest number of bushels per acre was subsoiled across the drains, the other parallel with them; ploughing across the drains he deems decidedly the best method. This was in 1838. In December, 1839, one of the fields was ploughed, but no traces remained of the subsoil-plough having been used. "I expected," he adds, "from the complete breaking up of the subsoil, that the parts would have remained distinct for years; but such was not the case; they had all run together, and were as compact as when first moved by the plough, without even the appearance of a water-shake or fissure. This I was not prepared to expect. Separated by a fence only is another field of a similar description, which was fallow at the same time, but not subsoiled; the crop on this field was quite equal to the other. A neighbor subsoiled one acre of a field, which was sown with beans; this field I frequently saw through the summer, and, during that period, the part subsoiled was by no means superior to the other." Another farmer of Kirkleatham, in Yorkshire, whose experiments were conducted in a judicious and effectual manner, says that he is satisfied that subsoiling is of no permanent use upon his soil. The quality of the land in all these cases is the same, and consists of a level, uniform tract, of a peculiarly tenacious soil, called the lias clay, containing, by analysis, more than 43 per cent. of alumina, or pure clay. Mr. Black remarks, that "the soil which will receive the most permanent improvement from subsoil-ploughing is one in which silica predominates; indeed, all shallow soils of the lighter kinds will be improved by it, and particularly so if there is any moorland pan, or indurated incrustations, formed by the weight of the plough going for a number of years at the same depth, or from other causes. If the subsoil is of good quality, and a greater depth of furrow is wished for, the subsoil-plough may be used with great advantage; the percolation of water prepares the subsoil for amalgamation with the surface. Strong clayey land cannot be permanently improved by subsoil-ploughing."

I have felt bound to give these statements of intelligent practical farmers, though I might show many opposite results, which would lead one to suppose that there may have been something peculiar in the execution of the work. The same result has followed to a degree at Wimpole, the estate of the Earl of Hardwicke, a farm, which, in many respects, for careful management, and especially for the admirable arrangement and order observed in every thing connected with the farm premises, is not surpassed by any which has come under my observation.

It may, however, be considered as to a degree settled, that the very strong and adhesive clays in the application of this system of thorough-draining and subsoiling are to be looked at with a good deal of distrust; yet the certain success which has attended many attempts to drain a strong soil, by very deep and frequent draining, and by giving a fair opportunity, after the drains were opened, for the operation of excessive heat or excessive cold, in loosening and rending the soil, scarcely permits us to despair of some improvement in almost any case.

3. SUCCESS IN SUBSOILING SANDY AND LIGHT LANDS. — The application of this mode of improvement to light, sandy land may excite some surprise; and yet its beneficial effects, in such cases, have been, within my own knowledge, so fully established, that I think proper to dwell upon them at some length.

At the estate of Sir John Easthope, in Surrey, where many discouragements in the way of soil have been skilfully and successfully contended with, I saw the beneficial effects of subsoiling and draining strongly exemplified, in a soil of a sandy, gravelly, thin, porous character; the part so operated upon presenting a striking and beautiful contrast to another part of the field under the same cropping, which had not been so managed. To this experiment I have already referred. But more fully to illustrate this subject, I shall quote from a communication made by Mr. Denison, of Kilnwick Percy, Yorkshire, to H. S. Thompson, Esq., and given by him to the public in a valuable paper on subsoil-ploughing, in the Transactions of the Yorkshire Agricultural Society for 1840.

"Few have been hitherto met with who would not ridicule the idea of applying the operation of subsoil-ploughing and thorough-draining to light, blow-away sand; and as it is to this latter description of land that I have chiefly turned my attention and experiments, I will confine myself to what I really know and have experienced.

"I will now mention the mode in which I have brought a considerable tract of sandy land into cultivation; and I feel so thoroughly grateful to the subsoil-plough for the share it has had in my success, that I cannot do sufficient justice to it without fully explaining the system upon which I worked.

"The tract of land upon which I began was in extent about 400 acres, the principal part of which was rabbit warren. The general character of this tract was, that although, upon the whole, it was nearly a level, yet the surface was undulating; the sandy swells being covered with heather, and the hollows, a bed of aquatic plants, being for many months in winter entirely covered with water. Of the sandy hills, the soil, as far as I am able to judge, was a sterile, impalpable sand, having been heretofore cultivated, and again abandoned. About six or eight inches below the surface, this sandy soil seemed to become hardened into almost a sandstone, with the occurrence occasionally of an impervious bed of ironstone; presenting, wherever it did occur, a complete obstacle to the entrance of the ploughshare: generally speaking, however, these nodules, or beds of ironstone, lay at a depth somewhat below the ordinary ploughings. The marshy hollows were of a totally different nature; and their cultivation had never been attempted; an idea apparently having prevailed, that they were below the reach of drainage. When become dry, the soil of these hollows appeared to be a black vegetable mould, extending to a considerable depth; in some places peaty, in all containing a large proportion of inert vegetable matter.

"Upon considering the character of this tract of land, I thought that the principle of subsoiling would be equally applicable to the light, sandy hillocks and the marshy levels. Upon the higher grounds, it was obvious that, when under cultivation, the sun had very great power over the six or eight inches of stirred soil, and that thus vegetation was either burnt up, or, if a strong ground-wind came, there was danger of the contents of one field being blown into another. If, therefore, by stirring to the depth of sixteen instead of six inches, a greater volume of soil could be obtained, the power of retaining moisture would be proportionally increased, although the constituent parts of the surface remained unaltered; for I never contemplated that which by some is confounded with, and by others preferred to, subsoiling; I mean trench-ploughing. I am of opinion that in very few cases, if any, is the soil underneath more fitted for vegetation than that of the surface; least of all in a case like the present: a hungry, ferruginous subsoil could be no amendment upon a surface however sterile. Experience has shown that this theory is correct, and that, on sandy soils, the advantage to be derived from subsoiling is from obtaining a greater depth, and consequently a greater power to absorb moisture. On the level, marshy portions of this tract, the benefits, though not so obvious in theory, have proved equally clear in practice. The subsoil-plough has broken through the mass of tough vegetable matter, tearing up the roots of rushes and other fen weeds, which were beyond the reach of the common plough.

"My first operation was to carry a main drain through the whole estate; and this was not only an expensive job, but one also which required considerable precision; for upon the accuracy of its level depended the success of the whole drainage. Nor, when the drain was made, and the surface water conveyed away, was half the requisite treatment effected; for it proved that the sandy elevations, of which I have so often spoken, were the receptacles of springs, so that, in the whole of the estate I purchased, though termed a sandy waste, there was hardly a single acre which did not require draining previous to subsoiling.

"The main open drain being carried through, the next thing was to make main hollow drains, leading into it, bottomed with tiles, of the width and height of six inches, and covered with a sod, four inches thick, taken from the nearest hedge-side. I prefer sod to sticks, ling, or straw, for it allows the water to percolate freely, and does not shrink. The depth of these leading tiled drains varies much, according to the undulations of the surface. In some cases, it was necessary to cut them between six and seven feet deep, — altogether at an average of four feet. Into these drains were brought the smaller ones, laid with tiles of the width and height of three and a half inches, placed at every twelve yards apart, and of the same average depth as the others.

I consider it prudent to have in every five acres one leading drain, with an outlet into the main open one: the mouths of the outlets should be of wood kyanized, with a swing-door for the sake of preventing the possibility of the outlet being trodden up, or destroyed by frost acting upon the tiles.

"The above particulars have been given somewhat at length, from the conviction of the great importance of effectual drainage, and that, without it, subsoil-ploughing will do more harm than good.

"The first process, after the drains were complete, was in the months of March and April, to pare and burn, and to sow rape and turnips, drilled with half-inch bones and soot in the following month. The crop was not at all regular, being good where the soil was deep and black, but very bad where it was sandy; the sole being hard, and the action of the sun having great power to the very roots of the plants.

"In the winter of the same year, after the turnips and rape were consumed, I ploughed the land in the direction of the old furrows; and *the subsoil-plough followed*, worked by two oxen and four horses, loosening the hard, sandy sole on the higher ground, and tearing up the roots of the rushes, &c., on the low. In this state the land lay till the month of April following, when Finlayson's drag-harrow was applied across the ploughings, which brought up all the roots and rubbish to the surface; these were then raked off and burnt. I then sowed the black Tartarian oats, and ploughed them in: the ground was then harrowed and pressed down with a clod-crushing roller, made by Mr. Croskill, of Beverley, which implement has been of the greatest service to me in almost every stage and crop. It has been the means of consolidating the earth, which would otherwise have been too light, and it has kept the moisture in also. It has a decided advantage over every other kind of roller in this respect, because it leaves an uneven surface instead of a flat one, from which the rain, in sandy land especially, is apt to run off without nourishing or refreshing the crop.*

"The oats came out very healthy, and had no check: in sixteen weeks from the time of sowing, they were reaped, and, when threshed, yielded 10½ quarters per acre, 8 bushels per quarter, which were sold at 26 s. per quarter, — and this from land that was let two years before at 2 s. 6 d. per acre.

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* I shall hereafter describe this valuable agricultural implement. — H. C.

"I sowed forty acres with oats, of the same flat of land that had been pared and burnt, but not subsoil-ploughed, from want of time. The produce of this was not more than 3 qrs. per acre, and straw small and short — a very fair proof of the advantage of subsoiling.

"I have now 100 acres of wheat and oats growing on what was the very worst part of the whole property, and considered perfectly useless. It has been drained, pared, and burnt, and subsoiled exactly after the mode above detailed; and it looks as promising as what was so good last year. The land upon which I had potatoes, exhibits as decided a superiority."

4. SUCCESS OF SUBSOILING ON THIN, PEATY GROUND. — I think proper to subjoin the account of a Mr. Croft, of his operations upon a different kind of land.

Mr. Croft, of Hutton Bushel, who occupies some moorland on the calc-grit, thus describes the effect of subsoiling: —

"The surface soil is little more than half a spade deep, not positively peat, but next akin to it; at this time of year, (November,) it was always fetlock deep: under this is the pan, about two inches thick, and as hard as iron. We broke a pickaxe in getting a specimen. Below the pan is the rubbly soil, of which I also send a specimen for analysis. On this land nothing would grow. In summer, the crops would appear healthy and good, but before harvest, always dwindled away. I found it impossible to use the subsoil-plough with four horses; but by fixing a wheel to it, (which made it work much steadier,) and using six horses, we got on tolerably well, though it was very hard work for both horses and man. Immediately after subsoiling, I sowed oats with Sinclair's grass seeds. I had a full crop of oats, so heavy, indeed, that they were all flat on the ground, and not ripe till November: the seeds have been hard stocked all this year with sheep and *young horses*, which, as you know, are the worst of all stock for year-old seeds; but the herbage is good, and the land quite firm. Before subsoiling, the land was not worth 5 s. an acre: it is now let at a guinea."

"In this case, the advantages of subsoiling were great and immediate, and evidently arose from the drainage effected by breaking up the pan, which was impervious to water; whilst the rubble below was highly porous, and afforded a ready passage to the stagnant water which caused the previous sterility."

5. IMPORTANCE OF SUBSOILING AND DRAINING, AND THEIR APPLICATION TO THE UNITED STATES. — I hope no apology will be required by my readers for having gone so much at large into this subject. The thorough-draining and subsoil-ploughing of land constitute, in my judgment, the great modern improvement of English husbandry; and in their more extended application to lands which are now comparatively waste and profitless, or at best very restricted in their produce, and to lands which have been long cultivated, the productive capacities of which have been very imperfectly brought out, and to lands which have been productive, and hitherto supposed to have reached their maximum of yield, they seem destined to increase the products of the country beyond any calculations which have yet been made.

That such an improvement is applicable to many parts of the United States, — I mean especially the older states, where land has already reached a high value, — cannot be doubted. I know many farms and many tracts of country, where, by such a process, the product of the land might be expected to be doubled; and I have a confident hope that, in parts of the country where wheat now is liable to be thrown out by the severity of the frosts, or to suffer blight from the wetness of the soil, to which, in many cases, blight is to be attributed, we may, by means of this great improvement, be enabled to grow wheat with success. Our crops of potatoes, which we generally plant by preference in low lands, are often destroyed by excessive wetness arising from heavy rains, which remain on the top of the soil, for want of ready and sufficient drainage. I have known, in repeated instances, the seed to be destroyed in the spring; and the crop in the autumn to be rotted, in such cases, after it had become ready for the harvest.

6. OBJECTIONS TO THIS IMPROVEMENT. — I foresee only two or three objections to the adoption of this improvement in the United States. In laying drains of clay pipes or tiles, the very severe frosts, especially in the northern parts of the country, are liable to break them to pieces at the outlet of such drains; but

this may be guarded against by laying three feet of the ends of the drains with broken stones, through which the water would find its way. The pipes or tiles laid three feet, or even two feet, below the surface, would not be affected by the frost.

The next objection is in the difficulty of finding suitable persons to execute the work. An extensive system of draining, to be well executed, — and unless it can be well executed, it is better that it should not be attempted at all, — requires, in the laying out of the work, skill, and science, and experience; and as yet, a class of skilful, scientific, and experienced drainers can scarcely be said to exist among us. Time and demand, as in all other cases, may, however, soon produce them. The laborers, to execute the work, likewise, are not so readily found. No native American laborer, among the thousands whom I have known or employed, would have had patience, application, perseverance, and constancy sufficient to execute drains after the perfect and scrupulously exact manner in which they are made in England. Our habits of haste, our anxiety to arrive at our object by the shortest possible way, — for a genuine Yankee may always be known by his crossing a street, in spite of mud or dirt, diagonally, rather than going to the corner and crossing at right angles on the regular flagging, — our habitual conceit of our superior judgment, corresponding, in general, in a direct ratio with the ignorance of the party, which disdains to be directed or taught, are all national peculiarities, which operate against any minute, precise, and exact labor. There would be no difficulty, at any time, — such are the accustomed habits of the division of labor, — in finding any numbers of Englishmen, ten of whom are content to be employed during the whole of their lives in the formation of one pin at a time; but a Yankee would at once undertake to do the whole himself — with what advantage, as it respects the perfect execution of the article itself, I must leave others to judge. In many cases, however, we may take advantage of the labors and experience of those emigrant laborers who are planting themselves in vast numbers in a country affording singular advantages to a poor man, who is at the same time frugal, temperate, and industrious. Unless the work can be executed in the most careful, thorough, exact, and skilful manner, I strongly advise — if I may be allowed, with all possible respect and good-will, to give my advice — that it should not be undertaken. The half execution, or the imperfect execution, of it often brings many a good thing into disrepute, and proves a great bar to improvement.

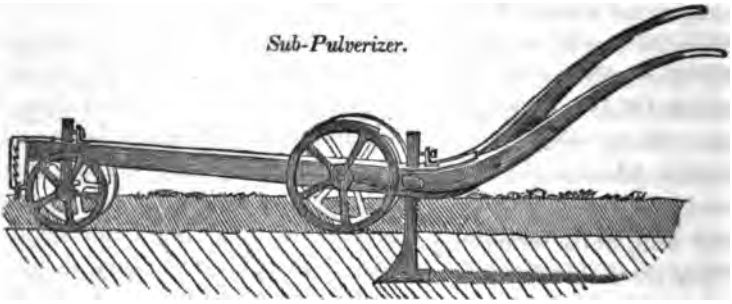
But the great objection which will be urged will undoubtedly be the want of capital, and the expensive character of such improvements. That they are expensive there can be no doubt; but in all such cases there are only two questions to be asked. First, have I the means of executing them? If the means are not within a man's reach, of course he should remember the fate of him who fell under general reproach, because "he began to build, and was not able to finish." The second question is, "Will the improvement pay? Will it produce an adequate return?" Then the cost of it is only to be considered in reference to the return which it will make; and the agricultural improver, in such case, is to be governed by the same principles by which the conduct of shrewd men is directed and regulated in other business transactions.

I can only say, that, in England, with scarcely an exception, as far as I have seen, the improvement is sure to be remunerative in a very high degree; and for that reason the government are proposing a most beneficent measure in offering the loan of capital, upon adequate security, for the accomplishment of such improvements, and in other cases allowing the owners of entailed estates to raise a certain amount upon the mortgage of such estates for the same purpose. Within my own observation, in my own country, where such improvements have been judiciously effected, though on a comparatively very limited scale, the result has afforded an ample compensation. I know quite well how all agricultural improvements, involving a considerable outlay of expense, and attended with some necessary delay in the returns, are constantly sneered at in our active and bustling community, by some persons, who are constantly in a state of the most feverish anxiety to find a shorter way to wealth, to reach it, if I may so say, on a railroad line, and by an express train; but I believe I may add with confidence, and that after not a short experience, that judicious investments in the profitable improvement of land, though they may have been at first expensive, have, in the course of time, proved as profitable as, and always much more secure than, most of the moneyed speculations in which the business public have been engaged.

7. Read's Subsoil Pulverizer. — I ought not to close this

subject of subsoiling and draining, without notice of an implement which has, in these cases, proved of great utility; I mean Read's subsoil pulverizer. I have already given a description of two subsoil-ploughs. This instrument, which can scarcely be called a plough, is intended to accomplish the same purpose. I have not seen it at work, but I have the testimony of several persons in its favor. The great advantages claimed for it are, that it does its work effectually and with much less expense of labor, on account of its suspension upon wheels, than other ploughs, requiring only two horses to use it. "The improvement," says the inventor, "consists in carrying the weight of the machine on two pairs of wheels of equal diameter, and placed in the same line, so that the implement offers no greater resistance to the cattle than is required by the action of the shares or tines to break up or stir the subsoil." It is represented as highly useful, when fitted with tines or hoes, for scarifying between rows of beans, turnips, mangel-wurzel, or potatoes, requiring one or two horses, and also for working hop-gardens. I subjoin an engraving of it. It is, of course, when used for subsoiling, designed to follow in the furrow of a common plough.

Sub-Pulverizer.



It will be interesting to my readers, if I subjoin the report of Mr. Parkes, the eminent engineer of the Royal Agricultural Society, upon the merits of this implement.

"An implement was produced at the Southampton meeting, with the merits of which the writer afterwards became fully acquainted. It was put to the test by the judges in a hard-baked soil. The pan, or old plough-floor, of this field, had evidently never been invaded by agricultural tools; below six inches it was as solid as centuries of ploughing and trampling can be conceived to have made a tenacious loam, aided by a drought of several weeks' duration. Mr. Read's pulverizer was put into the furrow opened by a plough, and set to work about six inches under it. The effect was '*perfectly beautiful*,' to use the judges' words. The old floor was split up into fragments, like broken tiles; the soil was separated and pulverized, not heaved up in great masses, and let fall again to its original berth — the common defect of the ponderous subsoil-ploughs; the depth was maintained invariably uniform, and a holder for the implement would be nearly unnecessary but for the circumstance of its coming out at the end of a furrow, and of setting in again. The uniformity of depth and regularity of motion are owing to the construction of the implement, which is as simple as it is novel. A straight beam, furnished with the usual pair of handles, is carried on four wheels, the leading pair being placed near the bridle, and the following pair near the after end of the beam. The stirrer or miner is let down through a mortise in the beam, immediately behind the after pair of wheels, and fixed to cut at any required depth. By this arrangement, the entire weight is carried on the wheels, which also preserve the action of the stirrer at all times parallel with the bottoms of the furrows on which they travel. This instrument required considerably less force of draught than any which had come under the observation of the judges. A mole-share has been applied to this implement, and used in Kent with excellent effect in making mole drains with a force of four horses; and by reason of its manageableness and accurate working, the implement has been found, by farmers in the same county, to facilitate drainage in clay soils, in a remarkable manner, if used with due caution. They recommend that newly-drained clays be not broken up, in the first instance, to a depth beneath the furrow greater than six inches; that the share be set another season two or three inches lower, and so on gradually deepening the pulverized mass, rather than disrupting the whole at once."

Since this report was made, this implement has been much more extensively brought into use, and with universal approbation. It is a much less costly instrument than the subsoil-ploughs before described. It seems to me quite worth considering how far the application of such wheels to a common plough would be practicable and desirable. It would seem likely to facilitate very much the even holding of the plough, to diminish its friction in some measure, and to make it easier to preserve an equality of depth in ploughing, than by the common instrument. There are parties who will perfectly understand this, and who, if they deserve attention, will avail themselves of these suggestions.

CIII. — IRRIGATION.

1. **Theory of Irrigation.** — Irrigation, or watering land under growing crops, can scarcely be called a very frequent operation in English agriculture; yet I cannot imagine the process to be more beautifully or successfully carried out than in some examples which have here come under my notice. These I shall describe as well as I can.

When a sterile and unproductive waste is converted into a fruitful field, and land which yielded nothing is made to produce the most abundant crops, — when the simple element of water, which Heaven, in its unlimited goodness, pours out in most situations in such abundant profusion, becomes the kindling instrument of life and energy to the vegetable world, to be used or applied by human art at its pleasure, — a reflecting mind contemplates the beneficent results with an elevated and grateful admiration. In such cases, one sees the highest encouragement to further efforts; the limits of progress and improvement the imagination has not yet descried; and past victories prefigure future triumphs in this humble but most useful field of exertion.

That water is an important and indispensable element in vegetation, every one knows. That its elements constitute a portion of every plant, is well established. But in what particular way it operates to produce its effects, is not so well determined. Its operation, say some persons, is purely mechanical. It reduces the matters in the soil, the manures, and the mould, into a condition to supply the plants with the food which they require; yet, if the water becomes stagnant in the soil, its effects are pernicious. It serves, in the opinion of one eminent person, to wash the roots of the plants, relieving them from that excrementitious matter which exudes from their roots, and which, if suffered to remain, injures their health, and impedes their growth.

This may be so, but it is obviously purely conjectural. It opens a passage for the access of the air to the roots of the plants. This must be beneficial. It increases the temperature of the soil; but this must depend upon the relative condition between the soil and the water applied, which must vary under different circumstances. In the opinion of Sir Humphry Davy, "In the artificial watering of meadows, the beneficial effects depend upon many different causes, some chemical, some mechanical." This is certainly a safe opinion; but its chemical effects are not so easily determined. Let us hear the great authority.

"The atmosphere and the soil offer the same kind of nourishment to the leaves and roots. The former contains a comparatively inexhaustible supply of carbonic acid and ammonia; the latter, by means of its humus, generates constantly fresh carbonic acid, whilst, during the winter, rain and snow introduce into the soil a quantity of ammonia sufficient for the development of the leaves and blossoms."

"The complete, or, it may be said, the absolute insolubility, in cold water, of vegetable matter in progress of decay, (humus,) appears, on closer consideration, to be a most wise arrangement of nature. For if humus possessed even a smaller degree of solubility than that ascribed to the substance called *humic acid*, it must be dissolved by rain water. Thus the yearly irrigation of meadows, which lasts for several weeks, would remove a great part of it from the ground, and a heavy and continued rain would impoverish a soil. But it is soluble only when combined with oxygen; it can be taken up by water, therefore, only as carbonic acid.

"When kept in a dry place, humus may be preserved for centuries; but when moistened with water, it converts the surrounding oxygen into carbonic acid. As soon as the action of the air ceases, — that is, as soon as it is deprived of oxygen, — the humus suffers no further change. Its decay proceeds only when plants grow in the soil containing it; for they absorb by their roots the carbonic acid as it is formed." *

"It is because the water of rivers and streams contains oxygen in solution, that it effects the most complete and rapid putrefaction of the excrements contained in the soil, which it penetrates, and in which it is continually renewed. If it was the water alone, which produced this effect, marshy meadows should be most fertile. Hence it is not sufficient, in irrigating meadows, to convert them into marshes, by covering, for several months, their surface with water, which is not renewed; for the advantage of irrigation consists principally in supplying oxygen to the roots of plants. The quantity of water necessary for this purpose is very small, so that it is sufficient to cover the meadow with a very thin layer, if this be frequently renewed."*

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* Liebig's Agricultural Chemistry, p. 127.

These are the opinions entertained by different eminent individuals on the subject of irrigation. They cannot be said to contradict each other; but whether or not they reach the whole of the case, must, be left to the judgment of my reader. The beneficial and productive influences of this process in an agricultural view are perfectly established. Any person may perceive it at the breaking up of the spring, when the snow water is turned into a restricted channel down a bank, that there the verdure and the growth of the grass will sometimes exhibit a month's advance over other parts of the field. Every one perceives its effects, when a drought is followed by a copious rain, and the whole aspect of the fields is immediately changed. Whatever may be the theory, which we deem most reasonable, in respect to the operation of water upon vegetation, it is enough for all practical purposes to know the fact; and the knowledge of this fact, and the practice founded upon it, are almost coincident with the art of cultivation. The amounts of the annual and fertilizing inundations of the Nile, and the plans for watering the fields after the dry season has commenced, must be well known to my readers. The productive influences of the overflowing of several of our great rivers upon their bottom and alluvial lands, are perfectly understood by the agricultural community. These, however, are usually charged with an enriching deposit, which is often made in considerable quantities, and the effects of which are always remarkable.

2. General Principles and Directions for Irrigation. — Some points respecting irrigation may be considered as well established, to which it is proper that I should refer. It is set-

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* Liebig's Agricultural Chemistry, p. 168.

tled that simple water, without any admixture, is in itself a great enricher of the soil, or perhaps, more properly, a great promoter of vegetation. If the water of irrigation is charged with enriching matters in a state of solution, its beneficial effects are of course increased. Waters charged with mineral substances, such as water strongly impregnated with iron from peat bogs, or water from copper mines, is pernicious to vegetation, as any one may see, who will visit the outlets of the copper mines of Cornwall. It is established, likewise, that water in irrigation, in order to produce its best effects, must not be suffered to stagnate upon the land, but must pass in a steady progress over it; and that this progress should be comparatively gentle, and not sudden and rapid. It is equally well established, that lands which it is proposed to irrigate, should be thoroughly drained, so that the water poured upon the land should not be suffered to stand in the land, nor upon it. The effect of stagnant water upon the surface, or the complete saturation of the soil, is to change the nature of the herbage, and to produce those grasses, which are coarse or innutritious, in place of the finer, sweeter, and more healthful. Yet it is not the mere transition of the water over the surface that is to be sought. It is desirable to have it soak into the ground, but not to remain there. Its speedy transition over the surface is to be effected by the inclination of the land from where it is received to the trench, furrow, or ditch, by which it is to be carried off. Its passing into the ground, and finding a speedy passage off, is to be effected by a system of thorough draining and subsoiling; for if the subsoil is impervious, the irrigated field becomes converted into a marsh. One of the most eminent farmers in Scotland, whose hospitality I had the pleasure of enjoying, but whose death since that time is deeply to be lamented,—Mr. Oliver, of Lochend, near Edinburgh,—who had a large extent of meadow, irrigated by the sewerage water from the city, found that, after his fields were thorough drained, the benefit of the irrigation was greatly increased; for by the descent of the sewerage water into the soil, as well as over it, the enriching portions of the manure in a state of solution were carried to the roots of the plants. In the irrigated meadows of the Duke of Portland,—for its extent one of the most beautiful and finished agricultural improvements which can be found, and which I shall presently fully describe,—he showed me, that portions of his irrigated lands, which had even been drained, continued to affect his sheep with the rot; and this evil was not remedied until the draining was carried to the depth of eight feet or more. Before that, without doubt, the stagnant water at the bottom prevented the water of irrigation from passing off, and may be said to have poisoned the whole ground.

In irrigation skilfully managed, the increase of product is often very great—twofold, fourfold, in many cases even fivefold. Even sands, which were barren, have, by irrigation, been made productive. Plants, in such cases, having once found a footing, by the spread and decay of their own roots, have at length formed a soil, and created around themselves the elements of fertility. The effect of pure water, I have already said, is considerable; but when this water brings with it the refuse of the streets and habitations of a town, in a state of solution, the effects, as we shall presently see, are most remarkable. I have seen it stated, that water issuing from a limestone soil, and strongly impregnated with lime in the form of a sulphate or other combination, has been employed with great success in irrigation. Such instances have not come under my observation; but I cannot doubt the effect, where the soil was of a nature to require that element. In respect to manures, or any of the constituents of plants, it is evident they can be taken up only in a state of the finest solution. Here homœopathy triumphs, and no human sense is acute enough to discern, no human scales are fine enough to measure, those infinitesimal atoms out of which the rough substance of the gnarled oak is formed.

It would be idle, in a work of this nature, to attempt to lay down any thing more than the general principles of irrigation. In the accomplishment of any particular work, all the localities are to be considered, and the effecting it upon any large scale would require considerable engineering skill.

Irrigation of land and inundation are not the same. The inundation of land resembles what I have already described under the process of warping, where, the land being enclosed by embankments, the water is admitted to flood the land, and is held fast until its floating riches are deposited. This can seldom be done without disadvantage upon a growing crop, unless when in its earliest stages of growth. Irrigation is the gradual filtering and spreading the water over the soil, and, where not too rapidly applied, may be done with safety at any period of the crop. This, however, can only apply to pure water. The application of turbid water, where a considerable amount of mud and earthy matters is held in suspension, or the application of sewerage water to a growing crop, would be liable to the same objections as inundation. I am referring, as must be obvious, to fields in grass, to which irrigation is applied; and not to fields under arable culture, to which it may be, but to which I have never seen it applied. What are called *catch-meadows*, is a form of irrigation upon side hills, where the water, after passing over a certain portion of the land, is caught in a trench, and again used for the irrigation of other portions of land. In a plan of irrigation, the first thing to be considered is the command of an adequate supply of water, and this, of course, at a level above the land to be irrigated. This may be obtained from a brook, whose course may be turned, or a portion of whose waters may be diverted for that purpose; or, as it is here sometimes obtained, by the collection of the water of springs bursting out upon the high lands into a common receptacle or reservoir, which may be tapped for the purpose of letting out the water, as it may be required. I recollect at Canterbury, in New Hampshire, at the establishment of the United Brethren, or Shaking Quakers, — certainly among the best farmers in the world, — that these industrious people, for the sake of establishing a mill power, much needed among them, had, by an embankment or dam between two high clay hills, formed a large basin or reservoir, which the melting of the snows in the spring, the rains, and some springs on the sides of these hills, would completely fill with water, furnishing a supply for the season; and which, passing into successive basins as it descended the hill, was used five times for mill purposes; such as a flouring mill, a threshing mill, a mill for sawing wood, a mill for grinding bark, and a mill for the dressing of leather. I could not help admiring the ingenuity of these people in creating a mill power where none existed before; and it is perfectly plain that, by such an arrangement, they might have executed an extensive system of irrigation, had it been thought proper so to apply the water. In some situations, where fuel and labor are not expensive, steam power might be employed with advantage to force water, and to form a reservoir at the height necessary for irrigating the land below. On a farm in Dedham, Massachusetts, situated upon an acclivity, at the foot of which ran a small brook, I saw that the farmer had formed a reservoir above his house and barn. Into this reservoir, through leaden pipes of a small bore, the water of the brook was forced up, by means of an hydraulic ram and forcing pump, itself operated by the running brook; and a supply of water was always maintained in the reservoir amply sufficient for the domestic purposes of the family, and the supply of the cattle in the yard. The water was forced a considerable distance, and the expense of the machinery was very trifling. The cost and labor of keeping it in operation were nothing, excepting that of opening and shutting the gate. The expense of the whole apparatus, excepting the reservoir, did not exceed five pounds, or twenty-five dollars. The farm would, in England, be considered a very small one, not exceeding one hundred acres; but it shows, just as much as a larger one, to what advantage the most simple contrivances may be applied. This water, thus raised, might have been used for the purposes of irrigation.

Where the supply of water is sufficient, it is carried along on the upper margin of the land to be drained in a trench or furrow; and, when it is required to throw the water over the land, the end of this trench or furrow is to be stopped, either by a gate or a damming up for the occasion, so that the water entering it may flow gently and evenly over its sides. It is plain that the water trench or furrow should be carried nearly upon a level; first, that the flowing of the water over the sides of the furrow or gutter may be equal and uniform; and, next, because any variation from a level would force the water to a particular point, either to prevent its equal diffusion over the field, or to occasion, perhaps, a rupture of the side of the trench, and an injury to the field itself. The variation from a level, recommended by some persons with a view to giving the water an easy flow in the trench or gutter, is only one inch fall in every ten feet.

Besides the formation of the trench or furrow, the surface to be irrigated requires to be made even, the knolls reduced, the hollow places filled, and the holes, occasioned by vermin of any kind, stopped, that the water may flow evenly over the whole. The degree of inclination, desirable in a field to be irrigated, is stated to be about ten feet in ninety; but although this may be found desirable, it is obvious that it cannot be under the control of the farmer, to any considerable extent, but at a very great expense. We must take the land as we find it; for few things are more costly than attempts materially, or to any great extent, to alter its shape. It would be prejudicial to undertake to irrigate our lands without the means of getting rid of the water, and without having a gradual, though not a rapid, transmission of the water over the surface; but in cases where the inclination is too great, the supply must be more gradually rendered.

The frequency with which water may be applied to meadows, and the length of time which it may be suffered to remain on them, are points to be considered. At Welbeck, at the Duke of Portland's, after the prepared land was sown with grass seeds, the water was brought upon them as soon as it was thought they would bear it; i. e., after they had become sufficiently rooted, and the ground consolidated around them. This would vary, according to the season, from one month to six. The great danger to be apprehended upon newly-sown lands is the washing away the dirt from their roots. The duke himself remarks that, "short of that, they cannot be watered too soon, or too long at a time, unless the land has very recently been drained, in which case it would not be well to increase the natural strength of the springs until the land had forgotten its wet propensities. On really dry land there are only two limits to the length of irrigation, viz., the want of water, and the want of consistency in the soil, so that it shall not be washed away from the roots of the grass."

After the grass had become sufficiently strong, the water was kept going over it for about four days, and then taken off. The grass was mown as soon as it was ready for the scythe, and the water again turned over. The same course was pursued upon the old grass land. About once a month, the water is turned on for three or four days at a time, according to the supply, and this throughout the year. When the water is abundant, it is applied oftener than once a month; but how long it should be kept on, is somewhat matter of judgment in reference to the weather and the state of the ground. The manager of the works chooses to keep it on until he sees its effects upon the grass.

Lord Hatherton, on his meadows at Teddesley Park, informs me, that they commence irrigation about the 1st of November, and the water remains three or four days on the land. If the supply is sufficient, it should be renewed once a fortnight. In a dry season, it is advisable to apply it immediately after cutting the grass; but it must not then be allowed to remain many hours in the same place, especially if the sun is powerful.

Mr. Oliver, at Lochend, where the sewerage water of the city was used, deemed it unsafe to apply the irrigation immediately after the cutting of the grass, but considered it altogether advisable to wait until the grass had acquired some growth. The sewerage water, in this case, was of great strength, and a different rule was applicable from a case where the water of irrigation was pure.

Mr. Roals, who farms some cold land one thousand feet above the level of the sea, in Somersetshire, and who has improved a considerable tract by irrigation, says, that "the water should never be suffered to remain in one place over the grass more than two or three days at a time without being changed; nor be turned upon the land in order to remain there during frost; but should the frost set in while the water is on, by no means alter it until the frost is gone; for if the surface is exposed, and the frost continues, it will most likely lift the land and kill the grass." *

These observations will have peculiar value in New England, where the frosts are severe, and where grass lands, upon which water stands in the winter, or lands upon which grain has been sown in the autumn, if particularly wet, are sure to suffer most severely from freezing.

I have already spoken of the quality of the water used for irrigation. At Lord Hatherton's, it is the water gathered from the different drains, in different parts of the farm, whose position was such that their supplies could be turned to this purpose. At the Duke of Portland's, a small river, called the Maun, running through the neighboring town of Mansfield, supplies the water of irrigation. After strong rains, when the washings of the streets and sewers of this town are poured into the river, its waters become quite turbid, and have a superior efficacy. The sediment deposited by a single watering, in such cases, is very

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* Journal of the Royal Agricultural Society, vol. vi. p. 520.

observable. I shall presently speak more at large of the application of sewerage water.

"In the management of the crops of grass upon irrigated meadows," says one whose practical knowledge of the subject allows him to speak with authority, "experience has shown that to let the grass grow to be too old, viz., until the seed of it is in a forward state, is productive of very great injury to the land. When the grass has been cut for hay in this state, and brown at bottom, the land does not recover for a great length of time. It is also found very desirable, after beginning any meadow, or portion of a meadow, which receives the water from one carrier, and at one time, that the consumption of it in a green state should be carried on as quickly as possible, so that in dry weather the water may not be kept off of it too long; for in that case it requires so much water before the land is saturated, and will allow the water to flow evenly over it, that much loss of time occurs in the next crop of grass."

I have thus touched upon the principal points connected with this great agricultural improvement, though there are some others to which I shall recur before I quit the subject; and I now proceed to speak of some principal experiments, which have come particularly under my observation.

3. **Welbeck, Nottinghamshire.** — The most extensive and most finished work of irrigation, or, as they are here called, of *water-meadows*, and to which I have repeatedly referred, is at Welbeck, in Nottinghamshire, at the residence of His Grace the Duke of Portland.* The water-meadows at Welbeck at first embraced

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* The Duke of Richmond, for whose constant kindness I should find it difficult to express my sense of obligation, did me the honor of a letter of introduction to the Duke of Portland, which I duly forwarded; and he, learning I was in his vicinity, was kind enough to send a messenger twenty miles to meet me, that I should appoint a time for my visit, when he would be at home, that he might himself, to use his own expression, "have the pleasure of personally showing me his improvements." The rules which I have prescribed to myself, and which I hold inflexible, do not allow me to speak further of my most instructive and delightful visit to that noble residence; yet it seems but just that I should, as I wish to do with the most delicate respect, allude to such examples as only illustrative of the uniform and universal treatment with which I have been honored during my protracted residence in this country, by the higher classes, both titled and untitled. These persons constitute a body, of whom I may say with truth, and I hope with-

more than three hundred acres; but they have since been considerably extended, and, when I was there, the improvement was still going on.

The land, before the improvement was commenced, was in part a thin, gravelly, and barren soil, and in part a peat bog, or swamp, and full of rushes and aquatic plants. The River Maun, which we should scarcely deem entitled to much more than the name of a brook, after sweeping through the town of Mansfield, a town of a population of a few thousand, made its way through the lower portion of these grounds. At what may be called its upper end, a portion of its water was diverted from its natural course, and, by an artificial channel, led along the margin of the meadows, which were to be irrigated, varying, in its passage, as the shape of the land varied; and this for a distance of five miles and a half, until, from the nature of the land, the artificial channel was brought into contact with the old channel; and here, a new dam being formed, the artificial channel crosses the bed of the river, and goes down on the other side, a distance of two miles farther.

At successive places, in the course of the artificial channel, sluice-ways are opened on the side, for the purpose of letting out the water; and these sluice-ways, besides being furnished with gates and valves, all of a perfect description, are most substantially laid with stone, wherever the inclination was more than one inch in five yards, so that no injury might be done to the meadows by too rapid a current of water. From these sluice-ways lateral gutters extend at right angles, into which the water is received, and thus diffused over the whole grounds. I subjoin a partial sketch of the general plan of the improvement, (p. 149,) which will render my description much more intelligible, and likewise an elevation of one of the shuttles, or, as we should call it, one of the gates, for the regulation of the passage of the water, (p. 150,) the construction of which appeared to me somewhat novel and ingenious, and so may be to some of my readers,

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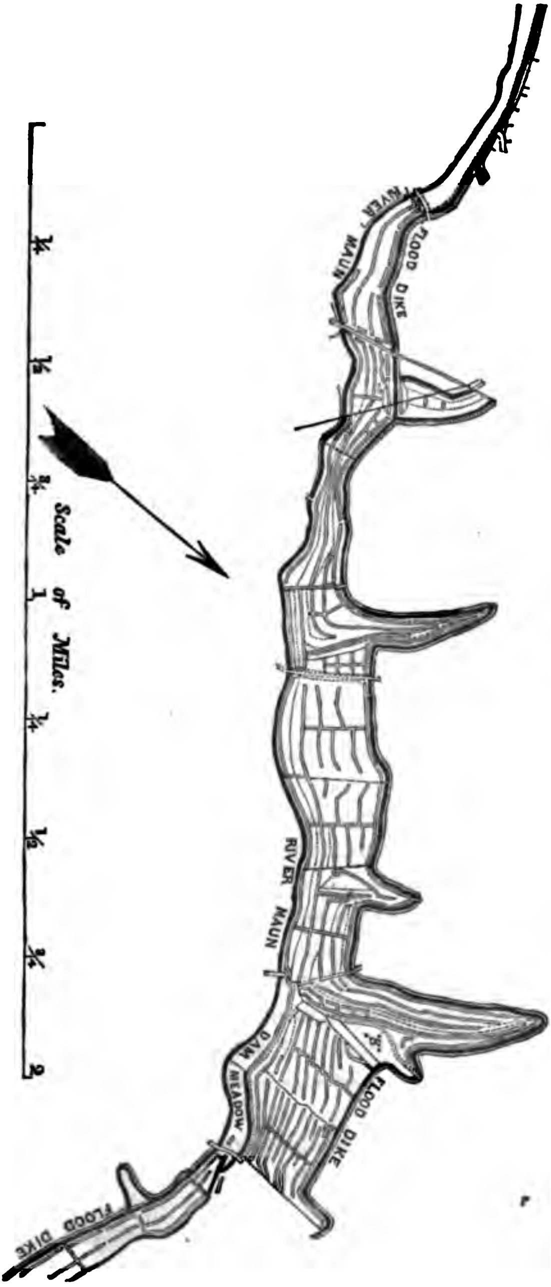
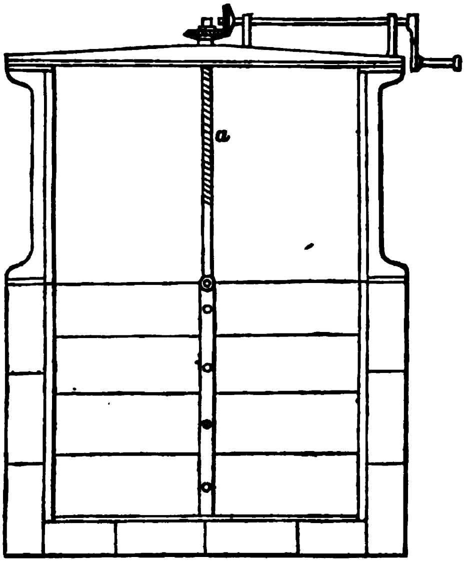
out offence, that, taken together, a class of men more polished and courteous, better educated, more enlightened, or more moral, has adorned no country and no period. The kindness which I have experienced has not, however, been limited to any class; and my numerous friends, in a condition of life more humble, may be sure that their strong claims upon my grateful respect are most cordially acknowledged, and can never be forgotten.

Plan of a Part of the Irrigated Meadows of His Grace the Duke of Portland, in the County of Nottingham, England; 1839.



though in its nature altogether simple, and probably familiar enough to every practical mechanic. The sketch is copied from the Journal of the Royal Agricultural Society, vol. i. p. 359.



But the conveyance of the water, and the formation of this artificial channel or canal, for so great a length, were only a part of this magnificent work. In order to render the irrigation of these lands easy, their whole surface was to be reduced to an equal flatness or inclination; consequently, knolls of even six and seven feet high were to be cut down, low places and holes filled up, and all the inequalities of the land corrected; and this was mainly done by the spade and wheelbarrow. The great point aimed at was, to render the slopes easy and equable; and, in order that, in cases where considerable elevations were levelled, a perfectly dead earth might not be left exposed, the top soil was first taken off, and then returned upon the places which had been dug down. This process had not been effectual to render these places as fertile as those parts which had not been subjected to so severe an operation; but time, under the continual influences of a rich vegetation, will probably effect that. The improvements, which were in progress when I visited the place, showed what an undertaking had been accomplished, and what an immense amount of labor expended. It was not merely that these grounds were to have their faces washed and their hair combed, but the levelling of these various inequalities required an extraordinary skill and an indefatigable and heroic perseverance. But the beauty of the whole work, as it presented itself to the eye, so nicely formed, and so bright and rich in its verdure and productiveness, was delightful; and this perfect and magnificent triumph of art and industry over adverse circumstances, most strikingly exemplified by a comparison with the adjoining land, which remained in its original inferior state, and had not been brought under the resuscitating and beautifying hand of improvement, compelled the highest admiration.

But the work which appeared was by no means the whole that had been done. The land had been all thoroughly drained, and, in some cases, to the depth of five feet. In some cases, the work had required to be twice done, because, when the land became saturated with the water of irrigation, new force was given to the natural springs, which then were rendered too strong for the outlets provided. The duke was kind enough to point out to me how indispensable it was to get rid of the bottom water in order to bring the lands into a sound state; and in one case, where the ground had been drained at the depth of five feet with tile-drains, the ground could not be laid dry until a spring at the side of the land was completely cut off, and a channel formed, so that the water might be conveyed quickly away. In one case, it was found necessary to sink a drain to the depth of twelve feet, in order to cut off a copious spring, which pressed upon the land. The system of thorough-draining, which I have already very fully discussed, may be sufficient to convey away all the rain water which follows, but not the water flowing from powerful springs in side hills, whose waters often press upon lower grounds in the neighborhood, and completely saturate them.

New evidence was given, in the progress of the work, that lands subjected to the process of irrigation, always suffer if there is too great flatness, and that it is of the highest importance to the full benefit of the operation, that, although a too rapid transmission of the water of irrigation is to be avoided, yet its progress should not be interrupted or delayed.

Besides the amount of labor expended in draining the lands, levelling inequalities, filling up hollows and holes, forming the channels, sluices, and dams, it will be considered that a great deal was required in grubbing the land, getting rid of the gorse, and heather, and rubbish, that covered considerable portions of it before the improvement was undertaken; and, previous to the levelling, the ground was ploughed, and a crop of turnips grown upon it, which were fed off by sheep. This was followed by a crop of barley, and then a second crop of turnips. The improvements having been completed, and the land levelled, these first crops, which were contemporaneous with the process of improvement, having been taken, the lands were regularly laid down to grass, and so have remained, requiring now no further manure, and yielding a most abundant product.

It has been found that the supply of water has been inadequate to the wants of the land in seasons of drought; and, to remedy this, the proprietor has formed, above the town of Mansfield, a reservoir of seventy acres, which is designed to do double duty, being first used to drive some mills in the town, and afterwards for the purposes of irrigation.

The productiveness of these meadows has much exceeded the expectations formed; and I shall quote from Mr. Denison's interesting account of them in the Journal of the Agricultural Society, of which I have already to some extent availed myself.

"These meadows are farmed in the following manner. Early in January, Southdown ewes, with lambs bred early for this purpose, are turned on the meadows. In this early season, they are assisted with cabbages; but the ewes and lambs always do well on the meadows; and they appear to be particularly healthy for the lambs, very few dying suddenly, as will often be the case on fresh seeds, [i. e., land newly laid down to grass.—H. C.] Ewes are put on with their lambs as they are born, and gain strength, and in this way, from January to the end of March, and in some parts till much later in the spring, even till late in May, they are devoted to ewes and lambs, feeding the lambs fat, which are sold, at that early season, at from 24 s. to 30 s. each. The land is then shut, some at the beginning of April, other portions later in rotation. The most forward meadows will be ready for cutting green by about the middle of May, and will yield from sixteen to twenty good cart-loads of green fodder per acre, which is carried to cattle in yards. In about six weeks, a second crop is ready, which, with the allowance of time necessary to clear the first crop from the ground, and to apply the water, will carry this second cutting to the middle of July. After this, an eddish [called in the United States *after-feed* or *fall-feed.* — H. C.] will be left to be eaten by sheep and cattle in the autumn and early winter. The meadows which are first cut will frequently allow of a third cutting of green food; but the eddish will, of course, in that case be of less value. Speaking, therefore, of the whole range of meadows, to say that, besides the sheep-feed in the spring, they will afford two green cuttings and an eddish, is to be rather under than above the mark. Some portions are allowed to stand for hay, and are mown, after having been stocked late, early in July, yielding two tons to the acre, and leaving, as in the other case, an eddish for the early winter." *

But it must be remembered, that this is not the whole of the profit gathered from these meadows. They require no manure to keep them in condition, beyond the water which is supplied to them, if that is to be called manure. But every acre of this irrigated land, in its produce consumed by cattle on the farm, supplies manure for five acres of other land; and this, on every account, must be considered an invaluable advantage.

The expense of these improvements has been very great; and the more especially, as every part of the work has been executed in the most substantial and beautiful manner. It seemed to me impossible to find a more finished work. The scale of expense here could form no rule for any such work in the United States, even should one in a much more humble form be in any case attempted. As to the result here, although, wherever these improvements are spoken of, I have heard the expense objected to, it was enough for me to know that the noble proprietor expressed himself entirely satisfied.† At the current value of land in this country, and of land which, from its own resources, without further expense than that of ordinary attention, is capable of keeping up its fertility, and, at the same time, to such an extraordinary extent administers to the fertility of other lands, and, to a degree, may be said almost to defy the seasons, it would seem that such an improvement would almost justify any expense incurred in effecting it. In any event, I could not help reflecting, with the highest delight, upon so useful, instructive, and beautiful an application of wealth; upon the important agricultural lessons which it explained and illustrated, upon the powerful stimulus to improvement, which such an example at once supplies and applies to all who witness it; and upon so striking a monument, which the proprietor has thus erected in honor of himself, adapted, not to astound, but to instruct; not to provoke envy, but to awaken gratitude; to carry down his memory to posterity in letters of universal respect, and more eloquent in his honor than the loftiest Corinthian granite column, or even the proudest regal mausoleum of ancient Egypt. But putting the actual pecuniary profit out of the question, the sum total of the expense of all these improvements, the actual creation of all these three hundred acres of most productive lands, with all its collateral and reduplicating advantages, does not half equal the expense of many a contested election, as formerly conducted, squandered in drunkenness, profligacy, and riot.

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* The Duke of Portland, speaking of the quality of the produce of these meadows, says, "There is reason to believe that water-meadow hay is not good for horses working on wind; but for all other purposes it is quite good. On account of its succulency, the grass is difficult to be made into hay, and requires much time. Horses of every description, and cattle, thrive greatly on the meadows themselves; and I should say that, unless they give the rot to sheep, they are the most wholesome pasture for them, as well as for horses and cattle; but my meadows are all perfectly dry."

† "The value of the land has been raised from the annual sum of £80 to that

4. TEDDESLEY, STAFFORDSHIRE. — The next great improvement in irrigation, which I had the pleasure of witnessing, was at the highly and most judiciously improved estate of Lord Hatherton, at Teddesley Park, in Staffordshire.*

Here he has undertaken, under the superintendence of a most competent manager and steward, to drain completely between five and six hundred acres of land, and has managed to convert

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of £3660, at a cost (from their commencement, in 1816, to their completion in 1837) of £40,000. The profit upon each acre, after defraying all expenses, is computed at nearly £12 a year, without taking into consideration the great benefit they are to the arable land adjoining them." — *Corringham's Report of Nottinghamshire.*

* To this gentleman's constant kindness, and, I may be allowed to add, intimate personal friendship, I am indebted for many of the advantages, and very much of the pleasure, which have attended my visit to England.

the water of drainage into a valuable mill power; and then leads it off for the purpose of irrigating about eighty-nine acres of land, taking in its way much of the drainage of the barn-yard, (where a stock of about two hundred head of cattle are constantly soiled,) which is collected in a large reservoir for this purpose, and sometimes carried out in a cart for the purpose of irrigation, and sometimes pumped upon a mixed heap of materials composted for manure, that it may enrich and decompose them. The water, in order to form the mill power, is first collected into a small reservoir, half a mile distant from the farm buildings, and then conveyed in covered drains to the mill house. In order to bring the water out at a proper level, it was necessary to sink a channel through a hard sandstone for a distance of about five hundred yards. "The stream of water was not sufficiently powerful to turn an undershot wheel; and to enable it to act with force, it was necessary to bring it out to the upper part of a wheel of thirty feet in diameter. This wheel has been placed in the rock thirty-five feet deep, and the head-way has been carried from the bottom through the rock, which comes out in a valley below, at the distance above mentioned of five hundred yards."

This mill power is applied to drive a threshing machine; to the cutting of hay and straw; to the crushing of oats and barley; to the grinding of malt, and to the turning of a circular saw; and it is obviously capable of further application. This is an immense advantage. The water, having performed this duty, is then conducted into the fields which are to be irrigated, where, by various channels, it is made to overflow and enrich these extensive grounds. The whole number of acres embraced in the farm is about thirteen hundred, only a portion of which is subjected to drainage; the number actually irrigated is eighty-nine. This land was originally of little comparative value, but is now highly productive. No manure is ever applied to these lands other than what is carried by the water in its mixture with the liquids from the barn-yard. The year before the last, notwithstanding the severe drought of the summer, they produced at least two tons of hay per acre. They are fed in the spring with sheep, and with cattle and sheep after being mowed. It would not be easy to estimate too highly the value of lands of such cheap and permanent productiveness, after they are once formed, and especially in reference to the means which they furnish of enriching other and less favored portions of the farm. The improvements on this farm are of a most substantial and complete character. The accomplishment of the object in view, in the most useful, thorough, and least expensive mode, is the governing principle pervading the whole establishment. Certainly one more judicious could not be adopted; and in this respect they present an example capable of being followed by farmers of limited means, whose improvements must be restricted to such only as will pay. The water obtained by drainage, in this case, happens to be favorable for irrigation. The whole expense of under-draining the land, of erecting water-wheel and machinery, and of irrigation, is estimated at £2733 2s. 2d., and the increased annual value of the estate is rated at £1013 2s. 4d. This results from draining 467 acres, and employing the drain water for mill purposes, and the irrigation of 89 acres of land; "affording a clear annual interest on the outlay of full 37 per cent."

5. Audley End, Essex. — The next improvement by irrigation I had the pleasure of inspecting was at Audley End, near Saffron Walden, the elegant residence of Lord Braybrooke. The improvements here, in this way, are upon a comparatively small scale; but extremely productive. They are on the lowlands, in the vicinity of a small stream or river. I cannot do so well as give an account of them in his lordship's own words.

"The water-meadows at Audley End were formed in 1841, from old pastures, without disturbing the surface except for the purpose of adjusting the levels, and cutting the ditches; but in consequence of the inequality of the ground, many hollow places were filled up with fresh moulds; and the product was not much increased the first year of irrigation.

"Although it was not possible to ascertain the exact amount of the crops for the succeeding three years, two of the three crops having been consumed in a green state on the ground, yet occasionally single rods taken indiscriminately from the first growth of grass have been weighed, in order to obtain a tolerable estimate of the general produce, and they afford the following result: —

First Time of Cutting.	Weight of Grass per Rod.	Weight of Hay per Rod.	Weight of Grass per Acre.		Weight of Hay per Acre.	
	lbs.	lbs.	Tons.	Cwt.	Tons.	Cwt.
May 1, 1843,	143	39	10	4	2	15
May 30, "	201	51	14	7	3	12
April 22, 1844,	152	38	10	17	2	14
May 15, "	211	62	15	1	4	8
May 23, 1845,	170	44	12	2	3	2
June 3, "	218	56	15	11	4	0

"In the end of July and beginning of August, 1844, a second cutting was made of the grass growing on the land above referred to, and carried to the homestead in a green state for consumption; and this crop appeared nearly as heavy as the first.

"It must be remembered that no deduction has been made for any waste of ground arising from the carriers and troughs; but it may be presumed, after allowing for this loss of surface, that the average produce yielded the three last years has been about thirty-one tons of grass, or eight tons of hay per acre. It appears, from the different periods of the year at which the crops arrived at maturity, that, even on irrigated meadows, the temperature of the atmosphere in the early part of the spring exercises considerable influence over the growth of the grass, where water is not always at command to apply to the meadows.

"Italian rye grass seems suitable for irrigation, as a patch at Audley End measured three feet two inches in height on the 30th of April, 1844."*

6. **SOMERSETSHIRE.**—I have already referred to Mr. Roals's account of his forming some catch-meadows, or meadows to be irrigated on very high lands, by collecting the water from some springs high up, and then bringing it down by successive gutters or trenches. "The water gutters were made to take the water that was drained from the springs above. He set out the watering gutters by a level, giving them one inch fall in every ten feet. They were cut nine inches wide and three deep. If the land has a gentle slope, the gutters may be put sixty feet from each other; but if it be very steep, and there is a good flow of

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* Journal of Royal Agricultural Society, vol. vi. p. 522.

water, they may be put seventy or eighty feet apart. When he finds the water sink too fast into the land, he spreads fine earth or road scrapings over the surface, in order to fill it up, that the water may pass over to the next catch-gutter. He has drained and formed into meadows, for irrigation, thirty acres, which yield from a ton to a ton and a half of hay per acre annually." This land, which, previous to these improvements, was valued by authority at 2 s. per acre rent, would now let for 25 s. This demonstrates the extraordinary value of this improvement.

His remarks subjoined to this account are too valuable to be omitted. "The sides of the mountains, in the north of England and Wales, might be converted into catch-meadows, in the same way that I have done mine, provided the water is of good quality, and the land can be made porous, to let the water filter gently down. I have never found turning water over old pasture do much good, as the grass that comes up is coarse and thin, and the hay, if mown, is not of good quality. If, therefore, old pasture is intended for meadow, it will answer best to break it up first, work it well, and seed it down with those grass seeds which are most congenial for water meadows."

The judgment of this farmer, in respect to the management of old pasture, seems at variance with the experience of Lord Braybrooke. But I suppose they are speaking of entirely different qualities of soil. The former is speaking of high mountain pasture, the latter of alluvial lands, which have been greatly enriched.

I shall conclude this part of my subject with the remarks of Philip Pusey, Esq., M. P., which are always deserving of the highest attention, and which are as applicable to many parts of the United States as to those places to which they immediately refer.

"I have known Mr. Roals's farm for many years. It stands alone on the summit of the wild Exmoor range of mountain land. If any one asserted, that, for a trifling outlay, he could enable heath-covered steeps to rival, in produce and value, the old grazing grounds of Northamptonshire, he would be regarded as a dreamer. But if any owner of moors will visit Somerset, or North Devon, he will ascertain the literal truth of the statement, as I did five years ago. All that is required is a streamlet trickling down the mountain side, or a torrent descending rapidly along the bottom of the glen. The profit of under-draining old arable land appears trifling when compared with the profit of thus forming catch-meadows, which, according to Mr. Roals, is more than one pound interest for two pounds invested. The two pages of this report, which state no more than Mr. Roals has himself done, contain a talisman, by which a mantle of luxuriant verdure might be spread over the mountain moors of Wales and Scotland, of Kerry and Cannemara."

New England, especially, and many parts of the other states, are full of sites and means for such improvements; and in many cases the expense and labor of levelling the land, bringing the water into a body, and placing it under control, would be met many times over by the profits of such improvements.

7. **Edinburgh.** — I come next to speak of a system of irrigation established in Edinburgh, which I looked at with a good deal of interest, where the sewerage water from the drains of the city are applied to grass lands in its neighborhood, which by this means are rendered most extraordinarily productive.

The drainage water from a large portion of the city of Edinburgh is collected into covered carriers and drains, and from these emptied into a small stream of water, very properly, as one may suppose in such case, called the *Foul Burn*, the term *burn* being the Scottish name for a small stream or brook. Here it passes along, in an open brook, among some flat lands, which, by proper arrangements, it is made to overflow. I should state that, before it reaches the places where it is thus diffused, it is received in tanks, where the more solid parts are deposited. It does not require any extraordinary acuteness of smell, on approaching these irrigated lands, to become satisfied that the waters, even after passing from the cisterns or tanks, are sufficiently charged with odoriferous particles held in suspension. Indeed, in visiting some parts of the old town in Edinburgh, of Glasgow, and of Dundee, it is difficult to persuade one's self that the inhabitants of those parts are not absolutely deficient in one particular sense. Whether, with the present habits prevailing in those places, this deficiency is to be considered an evil or a good, I shall not undertake to decide.

This water, thus received, is diffused over three hundred acres of land; and these lands are rendered productive to a most extraordinary degree. One of the principal proprietors, who held his land, under a long lease, at a rent of £5 per acre, and sub-let this irrigated land at £30 per acre, informed me that it was sometimes cut seven times in a season. The grass is carried into the city, a distance of two and three miles, for the support of the cows, which supply the city with milk. Different channels or gutters are formed for the admission of the water, so that the whole may be flooded. It is applied generally after every cutting, where the situation admits of it; but it is found advisable not to apply it immediately upon the grass being cut, nor before it has obtained some small growth.

The offensive exhalations from meadows thus treated have been the subject of prosecutions at law, as nuisances to health, by parties who derived no benefit from the operation, and whose sense of smell, therefore, was not, as I have known in some similar cases, benumbed or bribed by any pecuniary advantage. In the testimony adduced on these occasions, it has been stated that the rent for which some of these meadows are leased in small portions to cow-feeders, varies on an average from £20 to £30 per acre. Some of the richest meadows were let, in 1835, at £38 per acre; and in that season of scarce forage, 1826, £57, or $285, per acre, were obtained for the same meadows. "The waste land, called *Figget Whins*, containing thirty acres, and ten acres of poor, sandy soil adjoining them, were formed into water meadows, in 1821, at an expense of £1000. The pasture of the Figget Whins, containing thirty acres, used to be let for £40 per year, and that of the ten acres at £60. Now, the same ground, as meadows, lets for £15 or £20 an acre per year, and will probably let for more, as the land becomes more and more enriched;" that is, land which, before the irrigation, let for about 500 dollars per year, now, under this improvement, yields an annual rent of from 3000 to 4000 dollars. The irrigation is continued at different times, from the 1st of April to the middle of September.

The parties interested in defending the use of this water for irrigating these lands maintain that the grass produced in these meadows by this process supports in Edinburgh 3000 cows, and in Leith 600 cows. It is added, "that the parties interested in the lands estimate the compensation which would induce them to discontinue the practice, at £150,000, or $750,000.

This is stated as the sum which the proprietors at the west side of the city would be entitled to, exclusive of those at the east, were the practice abolished by government."

These are certainly most extraordinary results. The estimate of their pecuniary value may be exaggerated; and yet this would be difficult. The subject is of such immense importance, that I shall presently again refer to it. I may be allowed to add, in passing, that which I know will not be disdained, but the more highly appreciated, by the most cultivated mind — that the process, however humble, by which that which is offensive and poisonous may be changed into that which is agreeable and nutritious, and that which is loathsome be converted into the highest forms of fertility and beauty, is among the most affecting wonders of a beneficent and divine Providence.

8. WILLESDEN, MIDDLESEX. — The next example of irrigation, to which I shall refer, is of a different kind from those of which I have spoken; but it may properly be classed under the same head; and its character is so extraordinary, and its practical bearings so important, that I am anxious to present it to my readers. Having repeatedly visited the farm, and being personally acquainted with the enterprising proprietor, I am prepared to affirm the statements, however remarkable, which I shall present.

Mr. William Dickenson is the proprietor of a very large establishment of horses in London, which are kept for what is here called *jobbing;* that is, supplying noblemen, gentlemen, and others, with horses of the best description, and at their pleasure, for daily use or for journeys, by the week, or month, or year. In this case, the contractor furnishes as many horses as are agreed upon; and in the event of lameness, or disease, or incompetency, or at the hirer's own caprice, the latter may change his horses as often as he pleases. Whether these horses shall be kept by the contractor when the hirer is in the town, or by the hirer at his own stables, is matter of agreement. Such an arrangement is common, even with some of the richest men in the kingdom, whose fine teams are jobbed or hired; and who, in such case, are at least saved from always a disagreeable and most commonly a dangerous intercourse with those geese-pluckers, the horse-jockeys — a race of men pretty well known in all countries, who, when a favorable subject falls into their hands, will not leave willingly even a pin-feather, and who value such a bird, not for the fineness of his flesh, nor the beauty of his plumage, but for the *richness of his notes.*

These engagements oblige Mr. Dickenson to keep always on hand a large number of horses; and his stables in London may be considered as model stables, from the manner in which they are arranged, the condition in which the animals are kept, the perfect cleanliness which prevails in every department, and the admirable provision for securing an equable temperature and a thorough ventilation. Among other things, likewise, an ingenious provision is made for the saving of the urine of the animals, and, as far as possible, for preventing the escape of the ammonia, which high authorities deem its most valuable ingredient, in its transition from the stall to the tank in which it is finally collected from the various stables. To effect this, the floors of the stalls are laid either in brick, or stone, or a composition of the hardness of stone, with a gentle inclination of the floor from each side to the centre of the stall. Here an iron pipe is sunk, the whole length of the stall, similar to half a gun-barrel, with its concave side up, of course, into which the urine finds its way; and this is covered the whole length with a thin strap of iron, which can easily be lifted when the conduit needs cleaning. The urine goes into this channel unmixed with straw, and is conveyed by this pipe into a larger whole pipe in the rear of the stable, and is thence carried to the tank, which is placed in the outer yard. This tank is very securely covered, and is emptied into a watering cart by a pump, whenever occasion requires. Mr. Dickenson conceives there is great advantage in the liquid being thus, as far as possible, secured from the evaporation of its most valuable gases. The stalls are six and a half feet wide; ten feet in the whole length, with seven feet behind the mangers. The inclination of the floor from the sides to the centre, and from the front to the rear, is as little as possible, consistently with securing the passage of the urine. The number of horses kept here is, I believe, from 150 to 200. The liquid manure is, as far as possible, all saved for the use of his own farm. The solid parts of his manure are sold to farmers. This fact deserves particular notice. It is a point of the highest consideration. The stale of a horse is equal to about three gallons per day. If it were all saved, it would amount to about three and one half gallons.

Mr. Dickenson has a farm about five miles from his home in London, to which all his liquid manure is carried, and there distributed upon his growing crops, from such a cart as is usually employed for watering the streets of cities. When taken out there, it is mixed, before application, in the proportion of one part of urine to two of water; and the proportion to an acre is estimated at 1100 gallons of urine to 2200 of water; and this is applied as often as and soon after the grass is cut.

The plant which he cultivates on this land is the Italian rye grass, (*lolium Italicum*,) which he sows, in the autumn, say in September or October, formerly at the rate of four bushels per acre, but now, by an improved drill machine, at the rate of two bushels per acre; and upon looking at the two sowings, the one of four bushels per acre, the other of two bushels, the plants upon the latter sowing appeared to me more even and thick than where four bushels were sown in the usual way.

Mr. Dickenson thinks he has obtained, almost by mere accident, a very superior species of this valuable grass; and upon comparing various specimens, which he had under cultivation, and learning his own experience in the case, there seemed good reason for the belief.

"The Italian rye grass," says Mr. Lawson, "compared with any of the varieties of common rye grass, affords a stronger braird, arrives sooner at maturity, has a greater abundance of foliage, which is broader and of a lighter or more lively green color, grows considerably taller, is more upright, or less inclined to spread upon the ground; its spikes are longer; spikelets more thickly set; and, upon the whole, producing a less bulk of seed, which is smaller, has the awn adhering to it, and is generally little more than half the weight per bushel of that of common perennial rye grass (*lolium perenne*) when grown under similar circumstances." It is added, "If it be sown with clover, or lucern, its growth is so rapid that it will quickly choke them. It is eaten greedily by cattle, whether green or dry, and yields fifty per cent. of hay. After the field is harrowed, it is sown at the rate of from 16 to 18 pounds per acre, and the seed rolled in."

"The Italian rye grass will be valuable as an early grass; it retains its powers of growth to a late period in the season. A patch of it, which had flowered and ripened its seeds, was cut over in the first week in November; and, notwithstanding the frosts we have since had, occasionally pretty severe for the season of the year, [This is at Hamburgh. H. C.] at which period vegetation is nearly dormant, these plants have put forth new leaves, which at present (24th December) have attained the length of above a foot, showing a superiority to any other grass in producing herbage. This grass, too, is found to be more hardy than the common rye grass; for in the vicinity of Hamburgh, the common rye grass will not stand the winters when very severe; whereas the Italian rye grass withstands the severities of winter even when sown in September, and, consequently, the plants are young and tender when the frosts prevail."

Lord Hatherton sows annually, at Teddesley, about one hundred acres of rye grass. His letter to me states "that common rye grass is always sown with clover, about one peck of rye grass seed to the acre. Italian rye grass is generally sown alone, three bushels to the acre, and may be mown three times."

At Mr. Littledale's, Birkenhead, near Liverpool, I saw the Italian rye grass in a state of great luxuriance, the second year's growth; but it had been irrigated from the stable. Mr. Dickenson says to me, "I should continue the field two years under grass, and then plough up for grain; but the plant will continue stronger or weaker according to the treatment, and whether you take seed or not. The grower must judge a little for himself. The grass is excellent food for working horses, and makes an abundance of milk from cows. Ewes and lambs do better upon it than upon any thing I have ever given them."

The soil of Mr. Dickenson is a stiff clay, with which he mixes the rubbish gathered from the removal of old buildings in London, and consisting of sand and lime. In 1844, he mowed his rye grass ten times —

First in March, with about ten inches of grass;
April 13, a second time;
May 4, a third time;
May 25, a fourth time;
June 14, a fifth time;
July 22, a sixth time; with ripe seed and three loads of hay straw to the acre.

Immediately after each of these crops, the land was watered once from a London street water-cart, with one part of pure urine from the stables and two parts of water, the produce of each crop increasing with the temperature of the atmosphere from three quarters of a load per acre as hay to three loads per acre. The crop having shed a quantity of seed, he was doubtful the urine might injure its growing; so discontinued to water, but well harrowed it with iron harrows, and left it, expecting nothing more from it. It produced, however, three or four light crops afterwards.

In 1845, his first cutting was on the . 6th of April;
his second, ... 3d of May;
his third, ... 9th of June.

On the 22d of September, the fourth crop on the land measured three feet; the sixth crop, on land which had been previously mown five times, measured one foot and a half.

On the 26th of January of this year, 1846, I saw some rye grass, which had been cut two or three days previously from his fields, which measured 16 inches in length. This same field was mowed October 30th of the last year. It has been cut again the 8th of this month, (April,) 22 inches long.

Mr. Dickenson says that, when he has wished to relieve the tanks in the winter season, he has put on pure urine with excellent effect. He has also put on two parts urine and one water, and one part urine and one water, and two parts water and one urine. He is disposed to think, if there is such a quantity of urine as to render it indifferent how much is used, it may be applied pure to that description of grass, on almost all occasions, with success; but the effect would be greater on the land and plant in proportion to the temperature of the atmosphere. He advises to dilute more as the temperature rises, and for ordinary grasses to the extent of five or six parts of water. For the clover he thinks it ineffectual.

I was solicitous to know the actual amount of grass or hay probably obtained from an acre. He took the trouble to weigh accurately the produce of a yard square, of the fifth crop of grass of the season; and the following is his reply to me: —

"A yard of grass, cut in the presence of Captain Buller, weighed . . . . lbs. 5¾
Dried 12 days in the open air. . . . . " 2¼

Dried further 3 days in a room heated to 59° Fahrenheit, and weighed (standing weight) lbs. 2¾
Dried 3 days in a kitchen at 70° of heat, and weighed . . . . " 2 10 oz.
Roasted 2 hours before the fire, and weighed . " 2 6½ "

"This was the third crop of grass with the second crop of seed, and it is the only instance I have been particular to measure, cut and dry the produce, and this to satisfy one who had seen the previous crop cleared from the field; and this would be at the rate of about 5 tons 3 cwt. to the acre."

I saw in Manchester the produce of three cuttings of one season of Italian rye grass, the united length of which was more than 13 feet.

Such are the important statements, which I have verified upon my own repeated personal observation, and which I have the greatest pleasure in communicating to the farmers of the United States. I have no hesitation in saying that the verification of such extraordinary facts as these, and their communication to a wide extent, are infinitely more than a compensation for the toil, and labor, and expense, of my visit to this country; indeed, are not to be put for a moment in comparison with them; for if properly improved, this information must be worth millions to the country. I claim no priority of discovery, and I cannot presume that this information may not have reached the country in a hundred forms, in these days when the press pours out its treasures, as, in its great inundations, the Mississippi pours out its floods over an immense country, and sends its waters into every creek, and crevice, and fissure, of that wide expanse. But I know my friends will value a personal confirmation of these facts, and will feel, with me, greatly obliged to Mr. Dickenson for the full communication of the results of his experiments.

These experiments are most important in showing, first, what an amount of stock may be kept upon a small space of ground when under the best cultivation, and by means within the reach of many farmers. Where a piece of ground is devoted to this object, within an easily accessible distance from the stables or yards, it is very easy to see what a quantity of produce may be obtained for feeding animals in the stall, either horses, cows, or sheep. I put this question to Mr. Dickenson, asking his deliberate opinion, "How many horses, in a good season, may be fed from an acre, and for what length of time?" To which he replied, "Four horses in a straw yard consumed in one day seven yards by five and a half of the Italian rye grass, having no other food, and not being in work, but running loose in the yard at their own pleasure." The answer, I am aware, is indefinite, because the condition of the grass and the actual weight gathered at the time of cutting are not given; yet the fact is worth something as the foundation of a conjectural estimate. My readers may be curious to know the army allowance for a horse of dry feed per day — 14 lbs. of hay, 10 lbs. oats, 7 lbs. straw, each horse; with hard work, less hay and more corn; with little work, less corn and more hay.

But more important than any thing else is the illustration which these results give of the extraordinary value of urine as manure. I asked Mr. Dickenson if he would add the solid manure, if it were at hand; to which he replied, "No."

This is a very homely subject, I am aware; but it is one of the most important in the whole range of agricultural inquiry. In cities, it essentially concerns decency, cleanliness, and health; and I have yet to learn that to a mind with its moral taste not depraved, and not cursed by a habit of vile associations, there is any thing indecent in speaking of any of the processes of nature, which are all recuperative, wonderful, and beneficent. "*Honi soit qui mal y pense.*" Neither in Boston, New York, Philadelphia, nor indeed in any other city in the United States, have I known any systematic attempt to save the sewerage water for agricultural purposes; and yet I believe, at a very small expense a vast amount of the urine might be collected and carried out of the city by the neighboring farmers, without offence to any body, and with very great public and private advantage. I believe that, in many cases, it might, with a little pains, be collected from private and public houses, from stables, and from public urinals established in different parts of the city, which are very much wanted in the great thoroughfares, on grounds of health and comfort as well as decency; and that the farmers, who are now in the habit of buying solid manure, at the stables of the city, at very heavy prices, would find even a much greater advantage in removing the liquid manure, after proper arrangements for its collection and removal should have been made. A very high authority states that "human urine is particularly rich in nitrogen; and that it has been ascertained by analysis in this respect that one hundred parts of the urine of a healthy man are equal to thirteen hundred parts of the fresh dung of a horse, and to six hundred parts of the fresh dung of a cow."

"The urine of men and of carnivorous animals contains a large quantity of nitrogen, partly in the form of phosphates, partly as urea. Urea is converted, during putrefaction, into carbonate of ammonia; that is to say, it takes the form of the very salt which occurs in rain water. Human urine is the most powerful manure for all vegetables containing nitrogen; that of horses and horned cattle contains less of this element, but infinitely more than the solid excrements of these animals." *

I do not deem it necessary to cite any other authorities on this subject. Mr. Dickenson's experience in the case is conclusive; and he finds it for his advantage to save all the urine of his stables, to carry it in carts a distance of five miles, and is content to sell to those who will buy it his solid manure.

Next to the introduction of fresh water into a city, the disposition of its waste or sewerage, in respect to the sanatory condition of the population, is most important, and ought to occupy intensely the consideration of the public men, and men of influence, and the municipal authorities, in the United States. The influence of cleanliness upon health, comfort, and morals, in all cities or large aggregations of people, is of immense moment. In all public works of drainage, extreme care should be taken to guard against hurtful mistakes in the beginning; and to make, under the direction of the highest and most practical and experienced engineering skill, such arrangements as will be effectual and substantial without any mean reference to expense. Where any portion of the sewerage of a city can be saved without offence, and without danger to health, the results at Edinburgh, as evincing the value of such savings, show to how much consideration the matter is entitled. The agricultural value of one portion of this saving is estimated in Edinburgh at £150,000 sterling, which would be equal to a sum yielding an interest of $45,000 per year. This, we are to understand, is already obtained with very imperfect arrangements. After making a deduction of all the miscellaneous matters which go to swell

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* Liebig, p. 97.

the heap, "it is calculated that, in a city containing 100,000 inhabitants, there is produced of human manure 24,440 tons a year, sufficient, according to Liebig, to manure 50,000 acres of land, and, if conveyed to the soil by irrigation, worth at least £12,000 a year, [or $60,000,] and probably much more." If even one half of this could be so saved and applied, it is obvious how much would be gained.

The subject is now, in England, occupying, to an intense degree, the minds of many of the most distinguished men — politicians, magistrates, agriculturists, and philanthropists — in the kingdom. A company has been formed, with a capital of one million pounds sterling, and by men who are entirely above any plan of mere speculation, for the purpose of supplying towns with water, and availing of the drainage of large towns for agricultural purposes. Some of the first engineers in the kingdom are actively engaged in their service. One of them, Mr. James Smith, of Deanston, the eminent agricultural improver, whose system of thorough drainage and subsoiling may be said to constitute an era in agricultural improvement, has laid before the public a plan for conveying the sewerage of towns into the country for agricultural uses, by means of pipes, which is now being carried out in the city of Aberdeen, Scotland. His plan is, having collected the sewerage water of a town into a convenient receptacle, to force it, by means of a pump, to a sufficient altitude to send it into the country through large pipes, to be used for the purpose of irrigation of lands below the level where it is received, or of applying it to other lands by means of a pipe and hose.

I do not deem it necessary here to give all the elements of his calculation; but the result is that, in supplying an equal amount of the elements and requisites of vegetation, the cost of manuring one acre

with sewerage water, upon his plan, would be	£0	12 s.	9 d.
" guano, 2½ cwt. at 8 s.	1	0	0
" farm-yard manure, 15 tons, at 4 s. . . .	3	0	0

It is added that, "by an experiment made last season on a portion of meadow in Lancashire, applying at the rate of 15 tons of farm-yard manure per acre, and 3 cwt. of guano to another equal portion, their effects were found to be inferior to the 8 tons of sewerage water applied to a similar extent of ground. The amount of fertilizing matters contained in the water was not ascertained, but, assuming a similar quantity to that found in the Edinburgh sewer-water, the amount applied must have been about 1792 gallons per acre, which is less than the quantity which Mr. Smith proposes to apply to tillage land under his improved method of conveyance.

The proposition at first is startling, and may awaken incredulity. I can only say that the plan is proposed and approved by men of as much engineering skill, and of as much practical experience, as are to be found in the world. It certainly should not be condemned, unheard, in a day when cities are every where lighted with blazing air; information is communicated hundreds, and soon will be thousands, of miles, instantaneously, by means of electricity; and men are conveyed from one end of a continent to another, over wide-spreading lands, and heaving and boisterous oceans, with the swiftness of a swallow's flight, under the wings of a steam dragon.

Having now treated at large some of the prominent operations in English husbandry, I shall proceed to speak of other points in their management, which deserve attention.

CIV. — THE ROTATION OF CROPS.

The rotation of crops implies the alternation or succession of different crops on the same land. It is well ascertained by frequent and long experience, that where the same cultivated crop is frequently repeated on the same land, and allowed to perfect itself, its product will be diminished, and in some cases will fail altogether. The grasses would seem to present an exception in this case; but they are commonly mowed or depastured, and so do not ripen their seed. Where grasses proceed to perfection, certainly it may be said, in respect to many of them, that they are subject to the same rule. Forest-trees likewise may be considered as forming an exception, though it must be remembered that they supply their own nutriment from the decay of their own foliage, and that, although they bear fruit while young, yet they are many years in reaching a perfect maturity; and even in respect to forest-trees, nature, in many cases, clearly indicates the necessity of a change of production, in that where you cut down a forest of oak, it is usually followed by a growth of pine, and where you remove a forest of pine, there will spring up a growth of oak; the soft and the hard woods thus alternating with each other.

Sometimes it is found that the substitution of a single different crop is sufficient to prepare the land for the repetition of the former one. In some cases, the crop can be repeated with advantage after an interval of two, three, or more years. In some instances, the land, if left to itself, or what is called a *naked fallow*, becomes, after a year or more, prepared for the repetition of the first crop. The regular and plentiful manuring of the land will enable the land to bear the repetition, though there are cases in which even this ceases to restore the land to its former condition. It is found likewise that crops of the same family, though not of the same kind, will not follow each other to advantage. Thus the cereal grains, wheat, rye, barley, and oats, are considered improper to follow each other in immediate succession. The English divide their crops into two kinds, white and green crops. The grain crops are white crops; the green crops are the esculent vegetables, such as turnips, ruta-baga or swedes, carrots, parsnips, beets, cabbages, peas, beans; although the two latter, which are cultivated for their seeds, would seem more properly placed among the white crops. There is, however, another distinction between the narrow-leaved and the broad-leaved plants, which is to be considered in this case. The narrow-leaved plants, such as the grains and grasses, receive their nourishment mainly, as is supposed, from their roots, which are numerous and fibrous; the broad-leaved plants, such as turnips, cabbages, beans, and peas, and the clovers, receive their nourishment chiefly from the atmosphere, and do not therefore so severely tax the soil. This difference, it is supposed, allows of one of these crops being alternated with the other without prejudice to either. I am giving, in this case, the theory of others, which certainly, to a casual observer, seems plausible enough. I trust I may be allowed to demur to it, or at least to hold my judgment in suspense, because, to my mind, the proof is wanting. It remains, in my opinion, yet to be established that any plants receive their nourishment through their leaves.

It would be presumptuous to pronounce it impossible, but the proof does not appear conclusive. Two other theories have been suggested to account for the necessity or expediency of an alternation or change of crop. The first is, that every plant throws out from its roots, as excrement, that which is unfavorable to the growth of, or poisonous to, any plant of the same kind that may succeed it, but which, on the other hand, may be favorable to the growth, or be the proper food, of a plant of another kind. It is maintained, that by the cultivation of another kind of plant, of different wants from the former, this pernicious excrement is used up; or even by the suspension of cultivation, by what is termed a *naked fallow*, by the stirring or ploughing of the ground without cultivation of any crop, this offensive matter is destroyed, and the former plant may be again successfully cultivated.

The second opinion is, that different kinds of crops make demands of different elements from the soil; that the cultivation of a particular crop tends to exhaust the soil of the ingredients or elements which it particularly requires; that this element may be sometimes artificially supplied by manuring; or that the land being suffered to remain without cropping, or by a succession of different crops, nature itself will provide for a renewal of the deficient or exhausted element. The former theory is in a great measure abandoned; the latter is the prevalent opinion with those who claim a right to speak with authority.

The latter theory, however, is not without some difficulties or exceptions. Onions, for example, are cultivated successfully, year after year, on the same land, from preference, because it is found that the longer the land has been accustomed to this crop, the more favorable does it become to the growth of it. I have known cases in which Indian corn has been successfully cultivated forty years without interruption on the same land. A distinguished agricultural traveller and observer,* says that he has seen, "in the table lands of the Andes, wheat fields which had yielded excellent crops annually for more than two centuries; and that potatoes may come again and again upon the same soil; they are incessantly cultivated at Santa Fé and Quito, and nowhere are they of better quality."

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* Boussingault.

In all these cases, which seem to militate against a theory perfectly rational in itself, there may be circumstances undetected or unobserved, which, if known, would fully explain the exception. I do not mean to deny this theory, and certainly not to throw any discredit upon the aid which science may give to agriculture; but these matters are not so simple as we are disposed to think them.

The confidence and presumption of knowledge abate the desire of further attainment, and remove the stimulants to inquiry. Science has yet a great work to perform for agriculture; and when chemistry can, by analytical examination, show precisely what is wanted in any particular soil for the growth of any particular crop, and how it may be supplied, we shall hail the discovery as one of the highest importance, and the noblest triumph which it can achieve. We believe, at least we confidently hope, that this may be done. We know what has been promised in this matter, and wait patiently its fulfilment. Agriculture will then be reduced to a system of rules so simple and exact that the plainest mind cannot mistake the course to be pursued.

At present, we must be guided by practical experience. Most crops are found to diminish in their yield the more frequently they are repeated in immediate succession upon the same land. Manuring for every crop will not always prevent this, although it will commonly do it where an ample supply is to be had. Some crops, it would seem, will bear a repetition much less frequently than others. Red clover bears to be repeated only once in four or six years, and some farmers would introduce it into the course of crops only once in twelve years; yet here we are not without dissent, for an experienced and observing farmer says, it may be cultivated as often as we please, provided the soil is sufficiently consolidated. Flax, it is constantly said, cannot be successfully cultivated oftener than once in five years; yet in one of the counties of New York they cultivate it with advantage every other year, and the experiment in Ireland has been equally successful. There cannot, however, in spite of these exceptions, remain a doubt, that, in the present state of agricultural knowledge, there should be an alternation or rotation of crops, as the surest mode of obtaining the largest product from the ground, and of keeping up the condition of the soil. I have known rye sowed, year after year, on the same land, for a length of time, with a constantly-improving product; but in this case, clover was always sowed with the rye; and this clover, in a state of luxuriance, was always turned in by the plough with the rye stubble, or, as it is here termed, "smothered," preparatory to the land's being again sown with rye.

One great object in any rotation of crops, which might be adopted, should be to make the intermediate crop, which is supposed to be fed upon the land, prepare the land for the crop, which is to follow. Thus it is that a green crop, which is manured, will itself do much in manuring the land for a white crop. While the amount of manure which is applied to a green crop can hardly be excessive, the same manure, if applied to a white crop, would be likely to increase the straw at the expense of the grain, and render its growth so luxuriant, or, if the term be allowable, so plethoric, that it would be liable to disease or blight, or to perish by being lodged.

The course of crops varies in different localities, according to the nature of the soil and the climate; and the kinds of crops grown depend likewise much upon local circumstances, such as the vicinity of a market, and the demand which that market creates. The most common rotation, and that which goes, by way of eminence, by the name of the *Norfolk system*, is called a *fourshift* rotation, and consists of, 1st year, turnips; 2d, barley; 3d, clover; 4th, wheat. In this case, there is usually but one manuring or dunging for the course, and that is given to the turnips. But, then, under the best husbandry, the turnips are fed to sheep which are folded upon the land, the turnips generally being cut and given to them in troughs, the fold being formed of hurdles, and changed frequently; and the clover likewise is fed upon the ground by sheep. The wheat and the barley go to market; and the straw is reserved for feeding and for litter in the barn-yards and stalls. On an English farm, no straw is ever suffered to be sold or carried off the place, unless an equivalent in dung or other manure is brought on. In some parts of Kent, it is stated that wheat and beans are alternated continually. On a farm in Gloucestershire, much celebrated for its good management, turnips, potatoes, and wheat, constitute the alternation of crops, though sometimes a crop of vetches or rape intervenes, which is fed off upon the land. In this case, a great deal of manure is purchased and brought upon the land. In some places, in the county of Kent for example, a six years' course is recommended: thus, 1st, swedes, [ruta baga,] well manured, and fed off with sheep, who at the same time have a plentiful allowance of oil cake, than which nothing contributes more to the enriching of the manure; 2d year, barley or oats; 3d, clover; 4th, wheat; 5th, peas or beans; 6th, wheat. In this case, the wheat, the beans, and the peas, have a dressing of dung; and in some cases, in the third year, beans are substituted for clover; and in the fifth year, clover for peas and beans.

"On land of a second rate quality, the five-field course is common: 1st, turnips; 2d, barley; 3d, clover; 4th, wheat; 5th, oats. This is found to bring the clover tilth too often; to remedy which the following course is sometimes adopted: 1st, turnips; 2d, barley; 3d, half clover, half peas or tares; 4th, half wheat, half oats; 5th, half oats, half peas. This brings the clover round only once in ten years, when the crop becomes much more certain."

A very experienced farmer has been kind enough to communicate to me what he deems an eligible rotation for a "farm, of a heavy soil, varying from four to eight inches in depth, resting on a stratum of strong brick clay from two to three feet in thickness, the substratum being the red crumbly or dried marl, intermixed, in some places, with thin slaty stone, and containing occasionally gypsum. All the arable land has been drained with tiles, in the furrows or divisions of the land, which vary from five to nine yards in width, about eighteen inches deep. The cold springs, pressing beneath the stratum of clay, in the greater part of the farm, have been cut off in an effectual manner by a few large under-drains, varying from ten to sixteen feet in depth. About half the arable land is considered to be totally unfit for the growth of turnips; on the other half the cultivation of turnips has for several years been part of the rotation, and lately with considerable success, for the purpose of carting off into the farm-yards and pasture-grounds; but no part of the land is dry enough, or properly calculated for feeding off the turnips with sheep."

Each division of the farm consists of twelve fields or enclosures, and is worked on a double rotation of six years. The rotation has been, 1st, common turnips; 2d, barley; 3d, white clover and rye grass, pastured; 4th, ditto; 5th, wheat; 6th, winter tares; 7th, Swedish turnips; 8th, barley; 9th, red clover; 10th, wheat; 11th, beans; 12th, wheat.

In this case, the turnips, the first year, are manured with ten two-horse cart-loads of manure to the acre, well turned in in the spring. The crops of the third and fourth year are fed off by sheep on the land. The sixth year, the tares have a moderate dressing of manure. The seventh year, the Swedish turnips, besides twelve two-horse loads of manure, have likewise applied forty bushels of ashes and bone dust. The ninth year, a slight dressing of manure is applied to the land after the first crop is taken off for soiling. The eleventh year, the land is manured with seven or eight two-horse cart-loads of manure, applied before sowing in the spring.

The rotation of crops pursued by Mr. John Morton, on the Whitfield Example farm, which I had the pleasure of visiting, is for a clay soil, as follows: 1st year, swedes and mangel-wurzel; 2d year, wheat and beans; 3d, clover; 4th, wheat and oats, that is, part of the land in each; 5th, vetches, rye, early turnips; 6th, wheat.

On a sandy soil, the rotation is as follows: 1st, swedes and mangel-wurzel; 2d, barley; 3d, clover; 4th, oats; 5th, cabbage, potatoes; 6th, wheat.

On a limestone soil, 1st year, rye and turnips; 2d, barley; 3d, clover; 4th, oats; 5th, turnips; 6th, wheat.

I do not deem it necessary to cite any more examples of the rotation of crops; and my object has been, not to prescribe any particular rule of management, but merely to illustrate the practice which prevails here. How far it would be eligible, or adapted to the condition of agriculture, in the United States, is quite another question, and must receive a very different answer in different localities. Many of the crops which are cultivated here are not, within my knowledge, cultivated at all in the United States, such as vetches or tares, though I have myself tried them upon a small scale, and have known one or two farmers to experiment upon them in the same way; and, in the next place, there is here an incapacity to grow a crop which is common with us, — the maize, or Indian corn, — a crop, which, in my honest opinion, all its uses being considered, is the most valuable product that ever came out of the ground.

The examples which I have given will serve to illustrate the systematic form in which agriculture is pursued here. According to the rotation determined on, the farm is divided into portions, and each one comes, in its turn, into a regular course of cropping. With the tenant farmers, this is not a matter of choice, but is commonly strictly prescribed in the lease, and is not suffered to be departed from. The great principles of cultivation and management which they suggest must be obvious; first, that a regular change or rotation of crops is always advisable in order to secure the largest product from the land; next, that the white and the green crops should alternate with each other; that two white crops should not follow each other, and seldom two green crops; that the manure should be applied for the green crops, and that the green crops should always be consumed by stock upon the farm; and, where the nature of the land admits of it, by stock, sheep in particular, folded upon the land which it is desired to put into a condition for a grain crop.

Formerly, it was deemed indispensable to introduce into the course what is called a *naked fallow*, in which a season was lost; for, though the land was cultivated, no crop was grown. This was done for two reasons — first, because it was supposed that, in a course of cropping, the land occasionally required rest; but secondly, with a view of exterminating the weeds, or noxious plants with which the land was infested. The former doctrine is now exploded, and it is considered that, by the substitution of a different crop, the land may be occupied continually; and clover crops by their tap-roots, and all crops which are fed and expended upon the land on which they are grown, so far from being considered as exhausting, must be regarded as enriching crops. The second reason for a fallow must be admitted to have much force. The degree to which many fields here are infested with weeds, with charlock, dock, poppy, and, above all, with twitch grass, (*triticum repens*,) is most remarkable; and the latter, propagating itself, as it does, from even the smallest fibre or joint, cannot be got rid of without extreme pains, by harrowing, grubbing, and picking it out by forks and by hand. On a piece of ground under the process of being cleaned I have seen the collected heaps of it as thick and large as haycocks on a newly-mown field. A hoed crop, of course, presents an opportunity of cleaning the ground as effectually almost as a naked fallow.

It will be for the farmers in the United States to consider how far the rotation of crops deserves their attention, and, if any particular course be adopted, what is best suited to their particular condition or locality. The same course is obviously not alike adapted to soils of different character, or to places varying in climate and in their demands for particular articles of produce. I am quite aware that, at present, in the United States, there are few examples of what may be called a systematic agriculture; and in many parts of the country, especially in the new states, where the virgin soil is unexhausted, and in some cases its exuberant riches would seem almost inexhaustible, — for in parts of the western territories, in the prairies and bottom lands, I have seen the rich alluvial soil exposed to the depth of eighteen feet, — it would seem to be of little consequence to present generations by what course the land should be cultivated. But to the perfection of the art of agriculture, to the realization of its greatest products, and, above all, to the attainment of that great point of good husbandry, the obtaining of the largest and most profitable return from the land at the least expense of labor, at the least injury to the soil, and, as it may be hoped in many cases, with an actual benefit or improvement to the soil, without doubt an exact system of cultivation and a regular course of crops will be found indispensable. The climate of England and the southern parts of Scotland presents advantages which we in the Northern and Middle States, perhaps in most other parts of the United States, cannot enjoy. The mildness of the winters here enables them to fold their sheep, and to feed the crops to them in the fields where they grow, during any part of the season. In very rare instances are the sheep ever housed, or even sheltered or protected; and in many parts of the country the turnips are eaten by the sheep where they grew, or are pulled as they are wanted and given to them in the fold. Where this is not the case, the turnips are either *pitted* or *placed* where they grew. To "pit" them is to place them in heaps in the field, sometimes digging a hole of a foot deep to receive them, and, after bringing as many loads to the heap as is deemed convenient or proper, shaping the pile like the steep roof of a house, and, after putting on a layer of straw over the turnips, adding to this a layer of dirt of a sufficient thickness to secure them from frost. To "place" the turnips, is to pull two rows of turnips, and, without removing the tops or the earth from the bottoms, to place them close on each side of the intermediate row that is left in the ground. A plough is then passed down on each side, and the whole are covered by the earth being turned upon them. These are secured from frost, and are accessible at pleasure through the winter, and given to the stock as wanted.

My own conviction, and that founded upon no little personal experience and observation, is, that the farmers in the United States, where circumstances favor it, would find a great advantage in growing esculent vegetables for their stock, especially turnips, swedes, and mangel-wurzel; and where these are properly pitted in the fields, they may be preserved from the most severe frosts, and at the same time be accessible, in the coldest weather, at the southern end, which may be secured by bundles of straw, to be removed and replaced at pleasure. That, during our long winters, a supply of such vegetables would very much conduce to the health and comfort of our stock, that they would be found most valuable for cows in milk and in calf, and for fatting cattle and sheep, is certain; and the cultivation of them would yield an ample profit, and the return of manure from the consumption of them upon the farm would prove most valuable. In this way, likewise, the straw of the farm would be converted into rich manure.

It will be observed that, in any rotation of crops to which I have referred, there is little provision for hay. Comparatively, very little hay is grown, excepting for market, or for the horses on a farm; and what is grown is husbanded with the most exemplary care — with a care which would much astonish many of our farmers, whose habits in this respect are extremely wasteful. On many farms there are meadows in permanent grass; some portion of the clover crop is usually dried and cured; and when rye grass forms a part of the rotation, it is almost always converted into hay. The main dependence for the stock, with the exceptions above named, is upon the esculent vegetables and the straw. As soon as the spring advances, there is a supply of rye sown for the purpose of being fed green to the stock, or of winter vetches, and the farm horses are usually soiled through the summer upon the latter crop, of which I shall presently give a more particular account.

CV.—SOILING, OR HOUSE FEEDING.

The practice of soiling stock prevails to some, but not, within my observation, to a great, extent in England. The soiling of stock implies the keeping of them in stables or yards all the season, and bringing to them green feed, when it is to be obtained, cut fresh from the fields. I have not been able to get that exact information on the subject, which I should have desired; and perhaps it would be vain to look for it.

Work horses are almost universally soiled in England upon clover, rye grass, rye, vetches or tares, or rye and vetches sown together. These are sown expressly for this purpose. The horses are frequently kept upon them without any additional feed; but when on the road, or when the farm work is severe, they require grain of some sort in addition.

Sheep, as I have before said, which are in a course of preparation for the market, and sometimes store sheep, especially those which have lambs by their side, that are designed for market, are folded, and the tares cut green and conveyed to them, which may be considered as soiling. A large stock on Lord Hatherton's admirably managed farm at Teddesley Park, in Staffordshire, are soiled; and their good condition evinced the excellent care which was taken of them. In many cases, in small holdings, I have found the system pursued with great success. On Lord Gosford's estates in Ireland, under the judicious and excellent care of Mr. Blacker, who has the superintendence, as he informed me, of several hundreds of tenants, (such are the subdivisions of estates in that country,) I found that among many of these small tenants he had introduced the practice of soiling their cows. Several, whom I visited, were keeping in good health, and with great advantage, three or four cows, where formerly they kept but one, and that one in a half-starved condition. It is said that in Ireland a cow is sometimes recommended for her capacity of getting her own living by leaping hedge and ditch, and foraging any where at her pleasure. Under a system of soiling, that branch of her education might well be dispensed with, much to the advantage of the peace of the neighborhood.

That a great saving of food is effected by soiling there can be no doubt; no one rates it at less than two to one; many say that three animals, some assert with confidence that four animals, can be well kept upon the produce of land, if soiled, where not more than one could be kept if depastured. The difference, undoubtedly, in this respect, is very great in favor of soiling; but its expediency upon the whole, in any given case, will be affected by a variety of local circumstances.

The soiling of work horses on a farm is always to be advised. They require the most particular superintendence; but this can be given to them only when they are near at hand. They should be protected against those extreme changes of temperature from which they are likely to suffer if turned into a pasture at night after a hard day's work. They require to have their food prepared for and brought to them; otherwise much of the time, which should be given to sleep and repose, is necessarily devoted to obtaining their food; and a horse turned empty at night into a pasture, will be likely to pass a great part of that night in filling his stomach. The same remark applies also to working oxen. It is highly creditable to the English farmers that their work horses are attended to with the most particular and faithful care, as to cleaning, littering, feeding, working, and watering. I have referred already to the practice of one distinguished farmer, who never allowed his horses to be trimmed, or curried, or housed, against their inclination. He was of opinion, that Nature, in this respect, was the best guide; and that she gave the animals their thick and matted coat, in winter, when they required it, and it was, therefore, wrong to deprive them of it; and in the spring she took equal care in divesting them of the covering, which then became oppressive and superfluous. There may be some reason in this; but whenever I see either horses or men in this shaggy and wild-bear condition, I cannot help thinking that nature may be somewhat improved upon. It cannot be said of this farmer, however, that he did not give his horses the opportunity of sheltering themselves if so they chose; for he had warm sheds and open stalls, most amply littered, to which they might have recourse at pleasure. This latter circumstance, of leaving them loose, was a feature in his management much to be commended; for it seems a great cruelty, though not an infrequent practice, to tie a hard-working horse in a close box or stall, with a short halter, where he cannot stretch himself, nor lie down but in a constrained position.

Nothing, indeed, is more remarkable throughout England, as far as my observation has extended, than the care and kindness bestowed upon the horses; excepting always the omnibus and cab horses in London, who seem, like galley-slaves, to be sentenced to hard labor as a punishment, and the hunting horses, who, especially in what are called *steeple chases*, which are in fact only trials of speed under the most unfavorable circumstances, are subjected to a severity of usage absolutely barbarous. I had the pleasure of enjoying the hospitality of a family of high rank, at whose residence forty or fifty carriage and hunting horses were kept, and where it was the custom for the principal members of the family, and their guests, to visit, by a covered passage way, the stables late in the evening, to see that every thing was in order; that the grooms and their respective charges were in their places, and in proper condition; and that the noble animals, who contributed so essentially to their pleasure and comfort, were duly cared for. The establishment was a model of neatness and good management. I have had the pleasure to find many a farm stable, where the comfort and health of its occupants were provided for with a carefulness equally exemplary. I confess I never witnessed such kind, and only proper care bestowed upon these noble animals without a strong desire that some other animals employed in the labor of the farm, certainly not less noble, and whose toil is equally severe, were the objects of a similar care and kindness.

With respect to the soiling of sheep, it could rarely be practised on any extensive plan; but the folding of sheep for fattening, and with a view to enrich the land in the fields, where the produce grows, which may be considered as one form of soiling, is universally practised. Experiments have been made on the feeding of sheep entirely within a yard; and the result, with respect to an eminent farmer in Yorkshire, whose establishment I had the pleasure of visiting, seemed to show that much was gained by this process, inasmuch as the animals consumed a much less quantity of food, in the proportion of 30 to 50, than animals which had a free range; but later experiments, by other individuals, do not confirm these results. Mr. Pusey, for example, states, that he "kept ten Down lambs in a shed, and ten out of doors, weighing each lot regularly; but found the gain of weight rather on the side of the lambs fed out of doors." It is extremely difficult to say why one experiment succeeds, and another of the same kind fails or gives an entirely different result; but this is a frequent occurrence, and requires us to draw conclusions from single or from few facts with extreme caution. We can presume to be confident only when these facts are multiplied, and often repeated under the same circumstances, and always with the same results.

With respect to the soiling of cattle, it is the case with some farmers that their calves are never turned into the field until they are a year old, and that many cattle may be said to be wholly reared in the stall. The fat stock, which are sent to the Smithfield cattle-show, and much of what is designed for the market, are kept altogether in the stalls or in loose boxes, as they are here termed.

In regard to milch cows in the country, they are commonly depastured; but in the large dairy establishments of London and its vicinity, they are wholly soiled. After being once placed in the stalls, they are never untied, excepting in some cases where they are loosened for the purpose of being watered, until their milk ceases to be sufficient to meet the expense of their keeping. They are then fattened and sold to the butcher. The feed is cut and daily brought to them in a green state, sometimes from a considerable distance. In such a city, cows, if kept at all, must be kept in the house; and during the season when green feed is attainable, it is of course obtained, for its advantages in increasing the milk.

Two great advantages of soiling cattle are, first, the increase of manure; and second, the keeping of more cattle on the same land.

The increase of manure from soiling is very far beyond what would be supposed by any one not experienced. Where proper provision is made for this purpose, all the manure of the animals is saved, instead of being left and scattered either on the road side, or in the fields, to be dried up by the sun, or washed away by the rain; and it is at hand to be applied as the farmer shall choose. It gives him an opportunity of converting all his long litter, and the straw of his farm, into the most valuable of manure, by using it as an absorbent for a large amount of the liquid portions of the excrements of his cattle. It affords him likewise the power, by properly-constructed gutters and tanks, of saving his liquid manure — the best portion, if well managed, and, according to the estimation of many eminent farmers, compared with the solid portions of the manure, in point of value, full two to one.

The next great advantage of soiling is the increased stock which may be kept upon the same land. From the various facts which have come under my observation, where the soil is carefully and judiciously cultivated, and duly manured, and a proper rotation observed, I believe that on land under artificial grass or esculent crops, three animals may be soiled where one only is now grazed. I believe this may be done with equal or superior advantage to the health and thrift of the animals, and that, in most cases, the increase of valuable manure obtained in this way, will much more than pay for any extraordinary trouble of attendance.

Another advantage is in the saving of interior fences upon a farm. Where cattle are kept constantly in barns or yards, the necessity of enclosures is of course done away; and, separate from the saving of expense in the case, the convenience of cultivating in long lines and open fields, the saving of land, and the superior neatness of the cultivation, are great and obvious advantages.

The trouble of cutting and carrying the fodder for a large stock presents to many persons an insuperable objection to soiling. This, however, must depend on local circumstances, which every farmer must take into consideration for himself. Without doubt, in some cases it might be such as to render the experiment ineligible. The difficulty of finding a supply of green feed sufficiently early in the spring, is likewise made an objection. This may be an objection in many localities; but in England proper, where an ample supply of Swedish turnips, carrots, and mangel-wurzel, are grown, and where winter vetches, rye, Italian rye grass, and lucern, afford an early cutting, this objection does not apply. It has been objected that cows soiled will not give so much milk as when grazed; on the other hand, the testimony of some individuals, with whom I have become acquainted, establishes the contrary. At Teddesley, in Staffordshire, where a large stock is soiled, the opinion is, that the cows do not give so much milk as when grazed. At Glasnevin, Ireland, the opinion of the intelligent superintendent of that establishment is, that their production of milk under the soiling system is much greater than when grazed. In a trial lately reported upon the comparative advantages of feeding cows with malt or barley and other articles of food, it was found that, upon being taken from the fields to the stalls, the milk of these cows was considerably increased. It is difficult to make a comparison in the case upon which the matter may be confidently determined. The quality of milk must, to a degree, depend upon the nature, and its quantity upon the supply, of the food which the animal receives. Some animals naturally and constitutionally, from peculiarities or circumstances which have never yet been explained, secrete milk of a much richer quality than others. The Alderney or Guernsey cows are remarkable examples of this kind, their milk being much richer than that of any other breed of cows known. Yet that the quality of the milk is not wholly constitutional, but depends to a considerable degree upon the nature of the food on which the cow is fed, is well established. Its quantity, of course, depends upon the supply of food which the animal receives. It seems to be determined by experiments which have been made here, that, of all food, grass fed green will produce the largest secretions of milk. It is found, likewise, by experiment, that in order to the largest secretions of milk, the temperature in which the animal is placed must be comfortable; she must be free from external annoyances; and she must be "at ease in her mind." These things being equal, it is not easy to see why, under an ample supply of fresh grass eaten with a good appetite, there should not be an equal production of milk in the stall, as in the pasture.

In illustration of some of my remarks, and because I think it may gratify the curiosity of my readers, I will here quote from a report just presented to Parliament in relation to the trial of different articles of food upon two cows, with a view to determine the result upon the quantity and quality of their milk.

"The intestines are the reservoir in which the food is placed for the purpose of being absorbed into the blood. The rapidity with which the dissolved or digested matter is taken up must, it is obvious, depend upon the rate at which the vessels destined for this purpose act: these being set in motion by the heart, this again by the nervous system, and the latter by respiration, there is discernible a beautiful chain of connection between the oxygen of the atmosphere and the absorbed food. If the system described were always in equable movement, if no influences were occasionally present to interfere with its proper equilibrium, animals would be in the condition of plants, which possess absorbing apparatus, but are destitute of one powerful interfering agent in the animal economy; this is the brain and nervous system, upon the condition of which depend passions and emotions of the mind. It is principally by the study of this important apparatus that we derive our knowledge of what is peculiarly termed the *constitution* of animals. Without this system, animals would be merely chemical machines, and we might then predicate, in every case, the effects of particular influences, as one animal would then differ from another merely in the extent of its mechanism. This remark is to be kept in view in considering the subsequent experiments. The cows were very different in reference to their nervous condition. The white cow was quiet and steady, generally eating equal portions and producing equable quantities of milk. The brown cow, on the contrary, was fitful in her appetite, and, of consequence, was variable in the amount of her products. In proportion to her weight, she consumed a larger amount of food than her fellow, but always afforded less milk, and a greater amount of butter. The variable action of her organs is well exhibited in the first series of tables. When at pasture, she had given two pints less than the white cow, and immediately before the experiments, she gave the same quantity as her fellow. On her arrival in Glasgow, her milk greatly increased; but it soon began to diminish, although the same amount of food was continued. That the change was not produced by any alteration in the food is obvious from the steadier result afforded by the white cow, which was also supplied with an equal weight of fodder. The amount of milk given by the brown cow was as much as 26 lbs. per day, when she was fed with grass, and upon the same kind of food the quantity declined to 22 lbs.; while the milk produced by the white cow was, at the commencement of the experiment with grass, 23 lbs., and at the termination of the trial 21 lbs.; so that there was a falling off, in the case of the brown cow, to the extent of 4 lbs., and with the white cow only to the amount of 2 lbs. That this result was not merely owing to a deficiency of water was proved by experiment, which gave the same amount of water in the milk of both cows; but the quantity of butter afforded by the brown cow amounted to 11¼ lbs., while that of the white cow was 8⅛ lbs., in fourteen days, from 1427 lbs. of grass supplied to each animal. Again, when the animals were fed on steeped entire barley, the brown cow's milk fell from 22½ lbs. to 17½ lbs., while that of the white cow's only declined from 22 lbs. to 19½ lbs.; the brown cow falling off to the extent of 5 lbs., and the white only to the extent of 2½ lbs. These facts are sufficient to show that the two animals were constitutionally different. The occasional wild look of the brown cow, her tendency to gore those who approached her, her frequent startled aspect, all indicated a nervous state of excitement; the probable cause of which has been already alluded to. The result of these experiments seem to countenance the idea that, although a handsome external figure is not necessarily an indication of the highest capacity in a cow to produce milk and butter, yet that it may conduce to afford a steady supply of milk, inasmuch as it appears to indicate a proper relation between the organs." *

That stall-feeding does not necessarily tend to reduce the quantity of milk, seems satisfactorily established at the various milk establishments which I have visited, where it is often found that the quantity is increased by the improved system of feeding under which they are placed. One milkman, of large experience, has assured me that he can almost at pleasure, in some cases, increase the quantity of milk full an eighth by a change of feed, as, for example, by giving them an extra supply of raw potatoes in addition to their other food. In a comparison, likewise, between the two modes of feeding, it must be remarked, that cattle wholly grazed are liable to the changes made in their feed by the variations of the seasons, the grass being at one time abundant and most succulent; at another short, or dried up by drought. In the stable, their feed may be kept uniform throughout the season. Cows, with us, that are depastured, give a flush of milk in May and June, when the feed in the pastures is most luxuriant, but "fall away" greatly in their yield in August;

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* Parliamentary Report on feeding Cattle with Malt, 1846.

from which decline they but partially recover, when turned into the mowing fields in September and October, upon the aftermath, or rowen. Now, although they may not, at any time, in the stall, give as much milk as when turned into the pasture at the very height of the feed, yet, their keep being equal throughout the season, the yield of milk will be longer kept up; and the whole amount given throughout the year will probably be more than that obtained from animals which are wholly grazed, and left to encounter the vicissitudes of the seasons.

In any system of soiling, it would seem most important that the animals should be occasionally turned out into an open yard for some portion of the day, as essential to their health, rather than to remain tied in the same position, as they are compelled to be in many of the large dairy establishments in the cities, not only from one week or one month to another, but from the beginning to the end of the year. "It is known," say the commissioners on the state of health in large towns, "that tubercular consumption is very prevalent among the cows which supply milk to the inhabitants of some large towns, where they are immured during part of every year in dairies perfectly closed; and which, being too small for the number of animals which they contain, soon become filled with heated, vitiated air, for the removal of which no provision is made. This is remarkably the case with the cows belonging to the milkmen of Paris, which are annually carried off by consumption in considerable numbers. A confirmation of the influence of this cause is afforded by the exemption of the horse from consumption, although frequently placed in the same circumstances with the cows, but with intervals of exposure to fresh air, and the enjoyment of exercise. Where a number of horses, however, are collected together in ill-ventilated stables, they may become consumptive. A discovery of this kind was only lately made, as to the effect of defective ventilation on the cavalry horses in some of the government barracks in England; and it is stated that a saving of several thousand pounds per annum was effected by an easy improvement of the ventilation of the barracks near the metropolis." These statements seem to me to have a very important bearing upon the construction of our stables and barns, and the general treatment of our live stock. The health of our live stock is, I fear, not sufficiently regarded. I have already alluded to it; but the subject is of so great importance, that I may be allowed to reiterate my admonitions. Though they cannot tell their complaints, these are not the less severely felt; and the animal constitution is liable to the same irregularities within, and to the same injurious influences from without, in one case as in another, in the brute as in the human animal.

I have seen, as I have already remarked, several instances of soiling in this country; but, with the exception of large milk establishments in the towns, and one or two large farms in the country, they have been upon rather a restricted scale. I have said that horses are almost universally soiled; the same may be said of much of the fat stock, which is in preparation for an early market, and especially for the agricultural shows. Fatting-sheep, in England, are generally folded, and in most cases the feed is cut or pulled for them, and they are fed from mangers or troughs. Other stock is generally grazed, as with us. Indeed, in parts of the country, especially in Scotland and Ireland, there is a large portion of the country which does not admit of, or would not pay the expense of, cultivation, and this is devoted to grazing, as the only beneficial use to which it can be applied.

I am bound to say that soiling is not universally approved. Mr. Stephens, the eminent author of the Book of the Farm, says that he has tried twice the experiment of soiling his horses, but failed in both cases; at one time for want of cutting grass, the second cutting having entirely failed that year; and the other time, for want of straw for litter, until the arrival of the new crop.* The latter reason seems to me about as appropriate and valid an objection against soiling, as it would be to have said that his experiment of soiling failed because he had no stalls in which to tie his cattle, and no troughs from which to feed them. Litter is indispensable in order to reap from soiling all the advantages, which it may afford in the production of manure; but it is difficult to understand with what propriety it can be objected to the practice of soiling, that it fails, when that failure is not in any way the fault of the system, but grows out of the deficiency or neglect of him who makes the experiment. The former objection has a good deal of force; and it would be great imprudence or improvidence to undertake a system of soiling without an ample preparation against such contingencies. Mr. Dickenson's experiment, which I have so fully detailed in a preceding part of this Report, (p. 161,) and the experiments of the cow-feeders near Edinburgh, most clearly show what can be done.

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* Book of the Farm, vol. iii. p. 851.

It does not come within my province, in this case, to detail what has been done in the United States in the way of soiling. The experiments of Josiah Quincy, Esq., on his estate in Quincy, Mass., made with great intelligence and acuteness, are detailed most fully in the Reports of the Massachusetts Agricultural Society. I have in other publications referred to a dairy of Robert Smith, Esq., near Baltimore, where a hundred milch cows were soiled. Another similar establishment I have visited on Long Island, N. Y., where an equal or larger number of cows are soiled. I have likewise, in former reports, mentioned the admirable experiment of a small farmer, in Waltham, Mass., who, from three cows carefully soiled, and allowed to recreate themselves for two hours a day in the barn-yard, produced at the rate of thirty pounds of butter per week, for three months. But I will refer to some cases which have come under my observation here, always finding occasion to regret the extreme difficulty of obtaining from farmers in general very exact accounts of any of their farming operations.

I shall give first the experience of Mr. Skilling, the intelligent and skilful manager of the school farm, at Glasnevin, near Dublin.

At first, he was a country schoolmaster, having the management of four and a half acres of land. "When I adopted the house-feeding system," he says, "my neighbors laughed at me, and predicted that my cattle would die; others said the cattle would give no milk. I lived near a village, through which I led my cows twice a day to water. They had a good appearance, as they were well fed; and they ran through the village wild and full of spirit. This showed they were in no danger of *dying*; and when they saw (for I was closely watched) firkin after firkin of butter going to market, they began to think there could be no great deficiency in the milk. I fed them on mangel-wurzel and turnips; and when other cows were dry, mine were giving milk. During three years, I kept three cows, and sold £6 worth of butter each year, from each cow, besides having a sufficiency for a family of six persons."

When I visited Mr. Skilling's well-managed establishment, he was then soiling sixteen cows in clean, well-ventilated, and convenient stables. He states that these cows, upon an average, give him £15 10 s. a year, each, and this principally from the sale of the milk. He estimates "that a cow fed in the house will make twenty-five tons of liquid manure, which will be sufficient for an acre of ground." I am afraid in this case my friend overrates the quantity. He says, he can, "on an average, keep a cow on every two English acres of land." I believe that, with proper pains and cultivation, a cow may be kept upon less than two acres. I have known a cow very well kept upon one acre through the year, and a portion of hay annually sold from the same ground. "Such," he adds, "are the advantages of house-feeding. There may be difficulties in keeping cattle in houses; but people should have patience, and not let difficulties overcome them. The advantages that arise from house-feeding are a larger quantity of manure, and much more milk; and, such being the case, it would appear strange that men should continue to practise the old plan. The system is applicable to a large farm, as well as to a small one. In England, the farmers do not keep half a sufficient stock upon their farms. They keep a great number of sheep, but not sufficient to compensate for the short stock of cattle. But it may be objected that, on a very large farm, say 1000 acres, it is difficult to erect a cow-house sufficiently large to accommodate as many cattle as would be necessary. The difficulty can be easily obviated. Let a number of cottages be erected on the farm; and beside them let cow-houses be built, so that the persons residing in the cottages can take care of the cattle in the houses next to their own. Let the young cattle be in one house; the milch cattle in another; the fat cattle in another; and it will be found, at once, that the system is as applicable to a large farm as to a small one." Mr. Skilling, it will be seen from these statements, is of a sanguine temperament; but the observations of a man so experienced as he is are entitled certainly to a respectful hearing.

He goes on to say, "The house itself must be airy, well ventilated, and perfectly clean. The animals must be well curried and brushed every day." His stables and their occupants gave ample evidence that he practised what he preached. "There ought to be one particular person to superintend and pay attention to the feeding; and one of the most important parts of his duty is, to ascertain the appetite of every beast. Cows, like other animals, will eat less or more; and they ought to be supplied according as they require it, being kept rather with an appetite, than otherwise. As soon as the animal has eaten its food, all refuse should be immediately taken away, and nothing suffered to remain in the stalls before it. The cattle will know the hour of feeding as correctly as the clock tells it, and will be disappointed and fretted if neglected. This neglect is prejudicial both to milking and fattening. Every farmer who cultivates his land in a proper manner, will have plenty of food for his cows in the house, summer and winter, and of various kinds. Cows, like other animals, are capricious in their appetites; they will not agree with being constantly confined to the same kind of food. No matter how nutritious in itself, there ought to be a variety; a change, if possible, for every feed." This is the mode of feeding which, he says, he himself has found eligible. "I give six feeds in the day, summer and winter, beginning at 6 o'clock in the morning, and ending at 9 in the evening, viz., at 6, at 8, at 12, at 3, at 6, at 9. They get water in their stalls at 10 in the morning, and at 5 in the afternoon; they are likewise turned out one hour, from 10 to 11, where they exercise, and drink if they choose. The kinds of food I use chiefly are the following: In summer, at 6, I feed with perennial or Italian rye grass and clover; at 8, with cabbages or leaves; at 12, with cut hay and straw; [this feed is to prevent the action of too much green feed upon them; a cow in health ought never to be purging; if she is, both milk and flesh are running off;] at 3, upon vetches; at 6, upon mangel-wurzel leaves, rape, cleanings of ditches, or other refuse of the farm or garden; at 9, clover or grass, or this may again be dried feed, if the state of the bowels requires it. In winter, at 6, first feed with steamed food; at 8, with turnips, raw; at 12, with cut hay and straw; at 3, with mangel-wurzel raw; at 6, with steamed food; at 9, with hay and straw. Water must be given or offered, and plenty of salt used in the steamed food. This mode, after much experience, I have found highly advantageous for all my cattle." He adds, "I have ascertained that when my present farm was in pasture, it pastured eighteen cows in summer; but now it feeds sixteen cows and three horses, all the year round, and I have as large a proportion of grain crops on the same land as most other people, besides."

I have thought that these details, all of which came under my own observation, would be interesting to my readers; and I will refer to some experiments on a small scale, on the estate of Lord Gosford, in the county of Armagh, Ireland, already spoken of, under the management of William Blacker, Esq., who may be considered as the author of house feeding in Ireland.

I had the gratification of a most instructive visit with this gentleman, among several of his small tenants, who every where greeted him with a warmth of welcome which showed their deep sense of his kindness. Indeed, many of them, through his judicious and beneficent agency, had been recovered from a condition of want, discouragement, suffering, and debt, and placed in circumstances of independence, comfort, contentment, and improvement; and I know not who are more to be envied than those persons who have it in their power to confer such benefactions, and who are permitted to see the beneficent fruit of their labors.

I shall be excused if I interrupt the course of my subject to speak of the means by which these changes, which here meet the eye and warm the heart, and form such an affecting contrast to the indescribably wretched condition of many of the cottiers of Ireland, have been brought about.

The numerous tenantry among whom he was placed, and a large proportion of whom were the occupiers of very small holdings, labored under two great difficulties, — ignorance of the best mode, and the want of the means, of cultivating their grounds, — difficulties which press heavily upon a great portion of the Irish population. The best of all charities is that which helps the unfortunate to help themselves. To understand the condition of Ireland, — unlike, it is said, that which exists in any other part of the civilized world, — it is necessary to go into Ireland. My eye never before rested upon, my imagination could scarcely exaggerate, the state of destitution and degradation, as far as their condition was concerned, in which I saw millions of these people living. The whole blame of this condition is not to be charged, as is too often done, upon the landlords. If, as is well known, there are too many landlords who neglect, there are those who seek to perform, their duty, and to discharge their high responsibilities, and who, actuated by an ardent spirit of philanthropy, are sincerely anxious to ameliorate the condition of their dependents, and to raise them from their low estate. But what can be done with people who are satisfied to burrow in a mud cabin, or a mere hole in the earth, and to marry, and live, and to bring children into the world, upon poverty and potatoes? Mr. Blacker, with the coöperation of the nobleman whose estate he manages, has effected the most beneficial changes among his tenants, by stimulating their pride, by multiplying their wants, by calling out their self-respect, by teaching them the best modes of management, and assisting them to pursue these modes.

His first plan was to employ some respectable and skilful farmers from Scotland, well qualified to teach, who were to serve as agricultural instructors. They were themselves to occupy a small farm, on which they were to exhibit an example of the best mode of management and cultivation; and, within a prescribed district, they were to visit the cottiers and small tenants, and instruct them in these improvements, looking after them frequently, reporting them, and encouraging them by the promise of handsome premiums for superior skill and industry, to be bestowed at the annual agricultural meeting, at the close of the year. In addition to this, through his Scotch agents, or by himself, Mr. Blacker offered the tenants aid in the form of seeds, artificial manures, improved implements, and sometimes a cow, the expense of which was all to be ultimately reimbursed. The plan has succeeded admirably. One of the first visits was to a small farmer, who had been at one time negligent, addicted to intemperance, deeply in debt, and wholly discouraged, and without even a cow, so important a blessing in a poor man's family. His habits were now changed; he had applied himself most diligently to the cultivation and improvement of his little farm; he had paid his debts; he was keeping two or three cows, and now felt the pride and wore the port of a man. It would be difficult to say what superior benefaction he could have bestowed upon such a man; and the beneficence was gratefully appreciated; for there is a chord in the human heart from which the touch of disinterested kindness seldom fails to bring a response.

I will give the returns of some of these small tenants.

A. B. has fourteen acres. He keeps four cows and a horse. The sales from the produce of his cows amounted in the year to £17, beyond the supplies of his family. Under the system of house feeding, he says he can keep four cows where he could keep only one before. Such a place as this, it is clear, should not be burdened with a horse. Each acre of his land, he stated, gave him a profit of £5.

C. D. cultivated eight and a half acres, in potatoes, flax, oats, turnips, &c. &c. He kept two cows, but had wisely sold his horse. He paid £9 15s. rent, and had cleared, in the previous year, £43, exclusive of butter used in his family. His oats were a magnificent crop; and where they had been manured with the water in which his flax had been rotted, the beneficial effects of the application were most striking. He raised two pigs.

E. F. occupies nine acres. Had last year three cows; this year he is keeping four; sold last year about £40 of produce, exclusive of butter. His cows produce about seven pounds of butter each per week.

All this is spade husbandry and house feeding. I shall proceed to give some other statements, which did not come under my particular observation, but with which Mr. Blacker was kind enough to make me acquainted.

G. H. stated that he had fed his stock of four cows and two calves upon one acre and two roods of land * all summer, being about one rood and four perches for each cow, after allowing for the calves, and had three roods of turnips, and one of rape, for winter. His whole occupation amounted to eight acres and three roods of land. His stock, of four cows and two calves, he stated, late in the autumn, had been fed, through the summer and up to that time, upon clover and vetches, on the same piece of ground which formerly, in grazing, kept only one cow, and that poorly. This man added that he was satisfied that there was no way in which land could be made to produce so much, or by which it could be brought into such heart, as by the soiling system, and four-course rotation of crops. He was just beginning to feel the benefit of it, his land being now all perfectly clean, every inside ditch levelled, not a spot in the whole that was not productive, and not any of it whatever in pasture.

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* I suppose, in these cases, the Irish acre is intended, which, to the English statute acre, is as the square of 14 to the square of 11, or as 196 to 121.

I. J. states that, when he came to his farm, four years ago, he could only keep one cow, and two acres of such pasture as it afforded was only sufficient to summer-feed her; that he had gradually increased his stock from year to year, until he had now three good cows, and a horse, on his eight acres of land, and had now more acres manured than he then found roods.

K. L. states that where formerly he had only two cows, a heifer, and a pony, he now had five cows, two heifers, and one good horse, upon his sixteen acres, kept on clover and vetches in summer, on cabbage in the autumn, and turnips in the winter and spring.

M. N. occupied twenty-three acres of land. His stock was seven cows, two heifers, one calf, and two horses, which were kept in good condition; and besides this, he had nine hundred stooks of excellent oats, and an acre of flax.

O. P. occupied six acres of land. Two acres and two roods were in potatoes, one acre in turnips, and he produced about thirty barrels of oats. He house-fed three cows, three calves, and an ass; he made three firkins of butter; he had two pigs; he had to support a family of eleven persons; and yet he had twenty barrels of potatoes to sell.

Q. R. held four acres, one rood, and twenty perches of land. He had two acres of potatoes in arable land, and three roods in reclaimed bog, of which he had reclaimed two acres; he had one acre of turnips; he had ten barrels of oats to sell; he had made three firkins of butter during the summer; he had house-fed two cows and two heifers. He had thirteen in a family to support, and he expected to sell ten barrels of potatoes; had already sold three pigs at a profit, after paying their cost, of £5.

S. T. held five acres of land. He had two acres of potatoes, three roods of turnips, twenty perches of flax. He had house-fed three cows and a genet. He had made three firkins of butter, and had twenty-four barrels of oats and fifteen barrels of potatoes to sell.

I do not deem it necessary to multiply these examples, although more are within my reach. I need not point out the conclusions to which they lead. Two things, however, deserve particular attention. The first is, that none of the product of the land is lost or wasted. The second, which reveals the whole secret of success, is in the large quantity of manure which is obtained upon this system. It is confidently stated that, where every thing is well managed and saved, a single cow will furnish ample manure, in the course of the year, to be applied to an acre of ground. I do not recollect that, in any of the cases which I visited, any provision was made for saving the liquid manure in a tank, so as to be applied by sprinkling to the land. This, if properly done, as may be seen from Mr. Dickenson's example, would have greatly increased the resources of these small farmers.

How far the system is applicable in other cases, every farmer must determine from the circumstances in which he is placed. I have no hesitation in saying that there is no farmer, who keeps live stock, to whom the subject is not worthy of attention. Perhaps there is no farmer with whom it may not very advantageously be to a degree applicable. The moving spring of every farmer's success is his manure heap; and how the manure heap is to be created and enlarged every one knows.

The great matter to be considered is, how to obtain a supply of succulent food throughout the whole year. With us in the United States, the plant of Indian corn, for a part of the season, cut green, and as early as it will bear cutting, furnishes the richest and most abundant of all provision. It may be sown broadcast or in drills, and so as to furnish a succession of feed until the frost comes. This advantage cannot be had here.

The Italian rye grass, which I have already so fully described in speaking of Mr. Dickenson's management, is an admirable plant for this purpose. In addition to this, there is a species of rye, called *St. John's day rye*, lately introduced here, which grows luxuriantly, and comes into a state fit to be repeatedly cut very early. I saw this plant cultivated on Mr. Pusey's estate, and there brought into most advantageous contrast with the common rye, which was sown in the same field. I shall give Mr. Pusey's account of it.

"Some farmers do not approve of rye, for while young it gives but little food, and shoots up rapidly to a harsh stalk, which stock do not relish. This does not apply to the St. John's day rye. This plant, if sown in proper time, and on a suitable soil, presents itself to the scythe in a state palatable to horses for full three weeks or more. It will grow from six to seven feet high.

The time to sow it (in the climate of England) is the 24th of June, at all events before July. The condition of the soil must not be poor, and the produce will pay for good land. The soil needs to be compressed after sowing, if the land be at all light, by rolling or sheep treading."

In June of the following year, the farmer whom I have quoted above sent Mr. Pusey an account of his further success in the growth of this rye. The stalk was six feet in length, though it had not then flowered. He began to soil eight cart horses with it on the 13th of May, then three feet high, and four cows a week later. Both these kinds of stock ate nearly the whole of it with scarcely any waste; it had then been twenty-two days in use, and he expected its eatable state would extend through a month. He thinks he should have begun a week earlier, not waiting until it was three feet in height.

Mr. Pusey, whose growing crop I saw, "sowed some in July, 1843, on some poor, moory soil, without manure; it was fed off in the autumn, and again in the spring, yet produced, on little more than a quarter of an acre, thirteen bushels of seed. The seed was sown again last year, (1844,) in August, as soon as harvested. It produced on a sandy loam very good feed in the autumn; and in this backward spring, (1845,) it realized the description given of it, and established its character by covering four or five acres with a thick coat of herbage, in which the lambs were browsing breast-high, while there was little or no other feed in the neighborhood."

It is said to be called *St. John's day rye* "because it grows so rapidly that, if sown about St. John's day, it will be fit to mow green by the middle of September; and in favorable seasons, may be fed off again in November, without preventing its giving ample feed the next spring, and a good crop of grain at harvest."

This rye, in Belgium, is deemed inferior to the common rye in yield of grain, but "it has evidently two advantages over the common rye. It tillers so much as to produce double the quantity of herbage on the same space of ground. In one field, where the two varieties were growing together, the common rye, after twice feeding off, became so thin that I ploughed it up, while this new rye covers the ground with its third crop, as with its first. It is sweeter than the common rye when young, as is shown by its being preferred by the hares and rabbits. Its principal merit is, however, its superior sweetness in advanced growth, and the consequently longer time during which it remains fit for use as spring feed."

Mr. Baker, a distinguished farmer of Essex, speaks of having obtained seed from two different seedsmen, and having found that, for spring feed, one was a fortnight earlier than the other, and yielded double the amount of produce. By the use of this plant, he says, he is now able to support all his horses and neat stock for two or three weeks before his neighbors commence. From the middle of April last, (1845,) he has been enabled to maintain upwards of forty horses and colts, and fifty head of neat stock, the former up to the present time, (24th of May,) and the latter until the 14th of this month, almost without the assistance of hay. The chief difficulty he had to contend with, was, to remedy the great waste occasioned by the horses and stock in foddering; for, as the rye advanced in stem, the stock would eat only the most tender portion, and, if tares were sown in conjunction, would waste the greater part of the rye in the endeavor to extract them while feeding. To remedy this, he cut the whole into chaff, and, by the addition of a small quantity of hay, and about one half of sweet wheat or oat straw, which he gradually diminished as the season advanced, he obtained a description of food for which, for early use, he knew of nothing as an equivalent, in point of cheapness or utility, besides the advantage of gradually adopting the change from dry to green food without risk or inconvenience to the animal. The number of acres consumed, to the present time, did not exceed nine; and the land upon which it was grown was already in a forward state for turnips. The rye grown by Mr. Baker is understood to be different from the St. John's day rye.

For house feeding, likewise, lucern is sometimes cultivated, although not so extensively in England as I had expected to have found it. This requires to be sown on rich soil; broadcast, if the land is clean; but in narrow drills, so as to admit of being hoed, if it is likely to be infested with weeds, which, in truth, constitute a principal obstacle to its cultivation. It is believed there is no more nutritious food to be found for cattle and horses, and none from which so large a product can be obtained from an acre, save only Indian corn, in a favorable climate and soil. It is stated confidently, but perhaps extravagantly, that an acre of good lucern will keep four or five horses from May to October, when cut just as the flower opens. It requires a dry, rich, loamy soil. The climate of Scotland is said to be too cold for it; but I have known very good crops of it produced in the neighborhood of Boston, New England. Clover — the common red clover — furnishes an excellent article for soiling, scarcely inferior to any thing which can be found; but its cultivation is too familiar for me to enlarge upon it.

The article mainly depended on in England for soiling, especially for horses, is vetches or tares. These furnish a very large amount of feed, and there is at least one kind which may be cut more than once in a season. Of the vetches which are cultivated for the purpose of soiling in England there are two kinds; one, which will bear to be sown in the autumn; the other, which is sown in the spring, to afford late summer or autumn feed. As well as I could learn, there is no observable difference in them, but that one will endure the winter, and consequently will afford early spring feed, and the other kind will not endure the winter; and the general impression is, that these peculiarities are the result of cultivation and habit, rather than of original constitution, if the term may be so applied.

After the early and trying part of the season is past, the crops of turnips, swedes, mangel-wurzel, and various tribes of cabbage, under industrious and good cultivation, will furnish an abundant supply of food; in respect to some of them, first in their leaves, and next in their bulbs and roots. Rape is likewise cultivated very extensively, especially in Lincolnshire, for the folding and feeding of sheep. As far as my observation extended, it is not usually cut for sheep; but a temporary fence is put up round a portion of the field, and they are turned in upon it. This being eaten, another enclosure is made; and in this way they successively enter upon the different portions of the field.

That a variety of food is conducive to the health of the animals, and to the increase of the milk of the cows, seems well established by general opinion and by actual experiment. Dried food is much less conducive to milk and to fatness than green;

and the effect of dry straw is to produce almost immediately a great diminution of milk. Hay is conducive to health, and to milk, in proportion to the succulent state in which it has been cured, provided, however, it has attained some substantial growth before being cut.

I think it will be interesting to my readers, if I quote here from the report to which I have alluded, on a trial of some different kinds of food upon cattle, made under the direction of the government, and just published by their order. I cannot say that the report, as a whole, is altogether satisfactory, or that the conclusions arrived at are very definite. The remarks, however, which I shall quote, are very worthy of attention.

"That a change of diet is necessary for animals which are kept in a confined condition, is proved by the tables accompanying this report in a striking manner; and the results now obtained amply sustain the idea, supported by us some time ago, in reference to the dietary of human beings shut up in poor-houses and places of confinement. It was then argued that, in order to retain the human constitution in a healthy condition, variety of food should be properly attended to, and different species of diet were suggested as well calculated to supply a series of dishes to the poor. In the Asylum for the Houseless and in the House of Refuge, at Glasgow, the recommendations were followed out, and, according to the report of the treasurer, the dinner meals being varied two or three times every week, the change in the dietary is much relished by the inmates, and may have had some effect in the greater degree of health which has been evident among them of late. The analogy subsisting between the physical nature of human beings and of many of our domestic animals, would lead us to the conclusion, upon physiological grounds, that their dietary should be conducted upon precisely similar principles. To prove this by exact experiments, is a point, it will be admitted, of considerable importance to the agriculturist, although it may have been, as might be expected, surmised by many intelligent observers. Not only, however, is *variety* of food requisite for an animal in an artificial state, — it is found also to be beneficial to one in a condition more akin to that of nature; for it is upon this principle that we are able to account for the superior influence of old natural pastures, which consist of a variety of grasses and other plants, over those pastures which are formed of only one grass, in the production of fat cattle and good milk cows. To any one who considers with attention the experiments which have been detailed, there cannot remain a doubt in the mind, that cattle, and especially milk cows, in a state of confinement, would be benefited by a very frequent and entire change in their food. It might not be too much to say, that a daily modification in the dietary of such animals would be a sound scientific prescription."

I have deemed it important to go thus largely into the subject of soiling or house feeding, because I think it will enable many of the farmers in the United States, especially in the older states, to keep three times the amount of stock which they now keep, and to very much more advantage with regard to produce and profit, and especially to the improvement of their farms, than the system which they now pursue. The great means of improving our farms are in the amount of stock which we keep upon them, always premising, however, that that stock, to be profitably kept, must be well kept; and while every farmer loses who does not keep all the stock which his farm will carry, he perhaps loses still more who keeps more stock than he can keep well. But every effort should be made by a good farmer to increase the capacities of his farm to their utmost extent; and by the number of cattle and sheep which he can amply provide for, may be determined his means of enriching his farm and enlarging the profits of his husbandry.

I foresee two objections that may be argued against the adoption of the system of house feeding in the United States — the one, the expense of labor; the other, the trouble of undertaking it upon any extended scale. The first is a simple question of profit and loss; if its profits will be more than an equivalent for its expenses, the application of any amount of labor under such circumstances cannot be reasonably objected to. The trouble and care which it may bring with it are no further a reasonable objection to its adoption than to every other project of improvement. No good in life is obtained without its proportionate price; and to men who live by their farms, and therefore have an interest in making those farms as productive as possible, as to enterprising men engaged in trade or manufactures, it resolves itself into the simple question, whether it will prove sufficiently remunerative to compensate the labor and attention. The reply to this question will of necessity be qualified by many local circumstances, and must be left to every farmer's own decision.

CVI. — CROPS.

The island of Great Britain produces, of bread crops, wheat, oats, barley, and rye; and perhaps in no other part of the world has the cultivation as yet reached a greater degree of perfection. I am, however, far from believing that it has attained its highest point; and, if the extraordinary crops produced in some parts of the country evince what can, the inferior yield in other parts, without any ascertainable hinderances of climate or soil, show what should, be done. I believe there is no part of the island in which wheat may not be successfully cultivated. In the north, oats are more cultivated than wheat, and constitute there the principal bread of the people at large. Oaten bread, however, in that country, is found under certain forms at the tables of the rich and of the higher ranks, as well as among the lower classes; and though I consider it altogether inferior to the bread of Indian corn, — and such, indeed, is my honest opinion of wheat bread also, — yet it is agreeable to the taste, and its nutritiousness is undoubted. In Ireland, where fine wheat is grown, and where also a considerable portion of oatmeal is consumed, the food of a large mass of the people is potatoes, and of this not always a full supply.

1. Wheat, however, is to be considered as the standard grain, and the great crop of England, upon which the arable farmer mainly depends for his money returns from his farm, and for the payment of his labor and rent, and to which, therefore, his attention is constantly and principally directed.

Of wheats there are great varieties. In the Agricultural Museum at Edinburgh, first established by the most commendable enterprise of Mr. Lawson, but now the property of the Highland

and Agricultural Society of Scotland, a vast number of kinds are exhibited; and his account enumerates more than eighty different sorts. The common divisions are into bearded or beardless wheats, into thin skinned, or white, and hard or flint wheats, or into white or red wheats. The botanical distinctions would be of little consequence to my general readers. The white wheats,or thin skinned, yield the largest proportion of flour or starch; the flint wheats of gluten, which is the most nutritious part of the wheat. The colors white and red are not permanent distinctions, but are considered as attributable to the soil in which these two kinds are grown; the white wheat sometimes changing into a red, and the red into a white. No advantage would come from my enumerating the various kinds cultivated. Every district has its favorite wheat; and it is with wheat as with most other popular favorites — public opinion is continually changing. The results, too, with respect to the same kind of seed, are different under different cultivation, and are likewise materially affected by the season. Different markets, likewise, have their preferences for different kinds of wheat. The baker wants one kind of flour; the confectioner requires another. I shall presently specify some of the principal ones cultivated. The analysis of different wheats has shown a remarkable difference in the quantity of gluten in each; but it probably will be found that this more depends upon the soil and the species of manure applied, than upon any peculiarity in the seed itself.[*]

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[*] "A sack of Italian, Sicilian, or Russian (Odessa) flour, when tough in kneading, or, according to the baker, '*full of proof*,' or gluten, takes up, in consequence, from five to six gallons more water than a similar quantity of British flour, and makes, in consequence, from four to six more quartern loaves. When the wheat, in England, is not well harvested, it is frequently necessary, in order to make a loaf 'which will stand up in the oven,' and sell, to mix with it flours of the above description. Starch is perfectly white, while albumen, the same substance as white of egg, is of a grayish color; and gluten, by exposure to air, becomes brown. The flours called *fines* and *extrafines* are made from Dantzic wheats, when to be had. From their whiter color, and their taking up, in the formation of bread, less water than wheats from the south, they must contain more starch and less gluten and albumen. Our British wheats, used also for fines and extras, in which the former is known to abound, are also whiter; and, as articles of luxury, it is true that the whiter wheats bear a higher price. But flours from the south, from containing more gluten, are browner, and, seeming to be less well dressed than they are, and to contain more bran than they do, sell at a lower price: still they go farther, and make a more wholesome and nutritious bread. The intel-

There is another distinction of wheats — into autumn, or those which are sown in the autumn, and spring wheats, those which are sown in the spring. But this is undoubtedly an accidental and not a permanent or constitutional distinction. With care in the selection of the seed earliest ripe, after a succession of seasons, what was winter wheat may be converted into spring wheat; and by sowing spring wheat in the autumn, its season of ripening will be retarded, and after a while it will take its place among winter wheats.*

Of the average yield of wheat per acre throughout the kingdom, it is difficult to speak with any confidence, as no exact returns are collected, and conclusions of this sort must be almost wholly conjectural. Nor do I see what useful lesson is to be learned from combining the results of poor and negligent with those of the most liberal and skilful cultivation, and striking a general average between them, except to afford an excuse or palliative for the neglect and indolence of those who do not cultivate their lands as well as they might. What we require to know is, what can be done; and this is determined beyond all

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ligent laborer who bakes his own bread from seconds knows this well; it keeps him better up to his work than whiter flours." — *W. H. Hyett, Esq., Royal Agricultural Journal*, vol. ii. pt. i. p. 144.

"Proust found French wheat to contain 12.5 per cent. of gluten; Vogel found that the Bavarian contained 24 per cent.; Davy obtained 19 per cent. from winter, and 24 from summer, wheat; from Sicilian, 21, and from Barbary wheat, 19 per cent. The meal of Alsace wheat contains, according to Boussingault, 17.3 per cent. of gluten; that of wheat grown in the '*Jardin des Plantes*,' 26.7; and that of winter wheat, 3.33 per cent. An increase of animal manure gives rise, not only to an increase in the number of seeds, but also to a most remarkable difference in the proportion of the substances containing nitrogen, such as the gluten which they contain. One hundred parts of wheat grown on a soil manured with cow-dung (a manure containing the smallest quantity of nitrogen) afforded only 11.95 parts of gluten, and 64.34 parts of amylin, or starch, while the same quantity grown on a soil manured with human urine yielded the maximum of gluten, namely, 35.1 per cent." — *Liebig*, p. 94.

* We must guard here against a mistake which, I know, has been made, and with much loss and vexation. The Whittington wheat is called a spring wheat, but it must be sowed in February. We on the other side of the water, hearing of its excellent qualities, and supposing it to be a spring wheat in our sense of the term, sowed it in the last of March and in April, and it did not come into head, as the season was too short. Many persons blamed the seedsmen for having deceived them in selling them a winter for a spring wheat; but the mistake arose, as errors and faults often arise, from a different use of the terms in the two countries.

question when we learn what has been done. No good cultivator should willingly stop short of what has been reached by others, nor should even this satisfy him, if there is a possibility of going beyond it.

In statistical works, 26 bushels are put down as the average yield of wheat through the kingdom; a few years since, 18 bushels were named as the customary yield. This would argue a very great improvement. There are not a few who even now insist that 14 bushels are the average product, taking the whole kingdom together. This seems to me much too low. Among all the farms which I have visited, I have not found a single farmer who has rated his product so low. On the other hand, under good cultivation, I have scarcely ever found it less than 32 bushels. I have very frequently found it full 40 bushels. In the fens of Lincolnshire, on the redeemed land, I am informed, on the best authority, that the yield is very often from 7 to 8 quarters, that is, from 56 to 64 bushels per acre. A much higher amount than this has been named. One of the best farmers in the kingdom, in the county of Berks, assured me that the crop upon his large farm, in 1844–5, averaged 56 bushels to the acre; and it is well attested that a crop grown in Norfolk county, in the same year, produced 11 quarters 2 bushels 3 pecks per acre, that is to say, 90 bushels 3 pecks per acre — the largest crop on record, within my knowledge.

When I received from most credible authority the account of the last crop, so very extraordinary as it is, I felt the strongest desire to ascertain, if possible, by what means it was produced, and especially whether there was any peculiarity in the soil, to which so great a yield was to be ascribed. This desire was felt as strongly by other members of the Royal Agricultural Society; and they directed the very eminent chemist of the society, Professor Playfair, to make an analysis of the soil and report it. I shall give my readers this report at large, which has been published in their Journal.

Two portions of the soil — one of the surface, the other of the subsoil — were placed in his hands. "I place," he says, "for the information of the council, the analysis in two forms, one of these giving the actual statement of the analysis, the other indicating the probable method in which the ingredients are associated in the soil.

“1. Surface Soil.

In 100 parts as actually found.	
Organic matter,	2.43
Hydrate water,	2.60[*]
Carbonic acid,	0.92
Sulphuric acid,	0.09
Phosphoric acid,	0.38
Silicic acid and silica,	81.26
Peroxide of iron,	3.41
Alumina,	3.58
Lime,	1.28
Magnesia,	1.12
Potash,	0.80
Soda,	1.50
Chlorine,	a trace.
Loss on analysis,	0.63
	100.00

In 100 parts as contained in the soil.	
Organic matter,	2.43
Hydrate water,	2.60
Silica and silicic acid,	78.27
Peroxide of iron,	3.41
Carbonate of lime,	2.10
Sulphate of lime,	0.15
Phosphate of lime, (as in bones,)	0.08
Phosphate of magnesia,	0.58
Magnesia, (probably as a silicate,)	0.88
Alumina, (probably as a silicate,)	3.58
Silicate of potash,	1.58
Silicate of soda,	3.71
Chlorine, (in combination as salt,)	a trace.
Loss on analysis,	0.63
	100.00

“2. Subsoil.

In 100 parts as actually found.	
Organic matters free from ammonia,	1.20
Hydrate water,	2.60[†]
Carbonic acid,	0.04
Silica,	82.55
Peroxide of iron,	3.70
Lime,	0.69
Magnesia,	1.55
Alumina,	4.48
Potash,	0.60
Soda,	1.10
Chlorine,	1.26
Sulphuric acid,	0.16
Phosphoric acid,	a trace.
Loss on analysis,	0.07
	100.00

In 100 parts as contained in the soil.	
Organic matters free from ammonia,	1.20
Hydrate water,	2.60
Silica and silicic acid,	81.96
Peroxide of iron,	3.70
Carbonate of lime,	0.09
Lime, (probably as a silicate,)	0.58
Magnesia, (probably as a silicate,)	1.55
Alumina, (principally as a silicate,)	4.48
Sulphate of lime,	0.27
Chloride of sodium,	2.08
Silicate of potash,	1.19
Phosphoric acid,	a mere trace.
Loss on analysis,	0.30
	100.00

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[*] Water which is not driven off at the boiling point, 212°.

[†] Water not expelled by long-continued exposure to a water bath.

"The subsoil may be viewed as representing the soil in its natural condition, and, as such, is rich in every constituent essential to fertility, with the exception of phosphoric acid, of which substance scarcely a trace could be detected. All the iron in the soil exists in the state of peroxide, so that the plants may appropriate its constituents without injury. The presence of so much common salt in the subsoil is only explicable on the supposition that it has been washed by the rains from the upper to the lower soil, for we find it absent, except as a trace from the surface soil. The vicinity of the soil to the sea explains the origin of the salt."

"The upper soil has obviously been improved by manure containing phosphates, and perhaps also silicates. I regret that no information on this point accompanied the letter from the secretary of the Statham Farmer's Club. The soils, from the presence of the alkalies and the alkaline earths, and of all the proper acids in the subsoil, are admirably calculated to furnish plants with their proper food."

I give this account of the soil, upon which this extraordinary crop was produced, from a gentleman truly eminent for his science, with feelings of no little discouragement, as showing, in a case where the curiosity was most reasonable and intense to get at the secret of this remarkable success, and where chemical analysis seems to have done its best, that we are still in as much darkness as ever. His conjecture how the ingredients were probably mixed in the soil, as appears from the second part of each table; his supposition, in the absence of all information on the subject, that phosphates, and perhaps silicates, may have been supplied in the manure; the utter want of the phosphates in the soil, deemed so essential to vegetation and to the growth of a grain crop; and the impossibility, which I think every farmer must feel, of deducing from the result any practical conclusion whatever, — are circumstances in the case which can scarcely escape observation, and which I submit to the judgment of my readers without comment.

That, under any circumstances, we can command a crop, or insure any given amount, need not be said; but the extraordinary pains taken here in the preparation of the land and the culture of the crop are followed with all the success which is to be expected. I have a great many returns of 32 bushels and

40 bushels produced on an acre; and I am strongly inclined to believe that the average of good cultivation, in ordinary seasons, is seldom less than 32 bushels per acre. The product of good cultivation should be considered therefore as the standard crop, without reducing it by the much smaller crops of those who either cultivate negligently, or manure sparingly, or suffer their crops to be stifled with weeds.

In an experiment carefully made by a distinguished farmer * in Northamptonshire, who has given to the world, in a plain and practical manner, the results of his agricultural experience, the products per acre of six different kinds of wheat sown were as follows: —

The Essex brown yielded at the rate of	40 bush. ;		64 lbs. per bush.			
" Surrey white, ...	36	"	64	"	"	"
" Brown, (called clover,) . . .	40	"	63½	"	"	"
" Snow-drop white, ...	39	"	63	"	"	"
" Burwell brown, ...	45	"	63	"	"	"
" Whittington white, ...	38	"	62	"	"	"

Here were six different kinds, of which it must be admitted the yield was large, and shows what may be done.

In an experiment made by W. Miles, Esq., M. P., the produce, per acre, of sound wheat was 48 bushels; 42 bushels 2 pecks; 47 bushels; 35 bushels 3 pecks; 49 bushels.

The crops on a farm of P. Pusey, Esq. were, on one acre, at the rate of 37¾ bushels; on another, 45½ bushels; on another, 47½ bushels. "This, it will be remarked, was not a garden experiment, but applies to a whole field of wheat, and the amount was given by the occupier of the land."

W. L. Kidd, M. D., of Armagh, Ireland, informed me that he obtained at the rate of 50 bushels of 62 lbs., or about 28 cwt., per acre, and that there were persons in the neighborhood whose crops were still larger. The wheat was red wheat; the quality such as to command the highest price. The soil was a stiff clay recumbent on limestone.

Mr. Theadstow, of Booth, near Liverpool, informs me, that in 1844–5, on a piece of land less than a statute acre, he pro-

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* C. Hillyard, Esq., Thorpelands.

duced 64 bushels of wheat of 70 pounds the bushel. I will subjoin his statement in this case. "The soil is very light, consisting of a great portion of sand, and lying close to the sea-shore. The land, the previous year, had been trenched to the depth of about three feet, by hand labor, and well manured with horse and cow manure, and planted with potatoes. When the wheat was sown, the ordinary mode of cultivation was pursued. . Something short of two bushels of white Dantzic wheat was sown. The seed had been produced on land of a heavier nature than that on which it was sown here. The mode of sowing was broadcast; the time of sowing, the 1st of December. This is a mode of cultivation adopted generally on my farm, — universally with vegetables, — and produces sometimes uncommon roots. Some of the cabbages, which I have weighed, weighed 45 lbs. each." In some experiments made in Gloucestershire, the products were as follows, per acre, of good wheat: —

Brown's white prolific,	48	bush.	3 pecks;	weight,	62	lbs. per bush.
" red prolific, .	46	"	2 "	"	60½	" " "
Whittington white, .	48	"	. . . .	"	59	" " "
Old Herts white, . .	46	"	. . . .	"	61	" " "
Golden drop red, . .	49	"	. . . .	"	61½	" " "
Creeping wheat, (red,)	46	"	1 peck;	"	62½	" " "

The above were planted on a gravelly loam, (clover lay,) in a high state of cultivation.

In the same county, in another case, the products were as subjoined. Cobham wheat, per acre, 42 bushels; Brown's white Chevalier, 44 bushels; yellow Chevalier, 36 bushels; Whittington white, 38½ bushels; Hertfordshire white, 39 bushels; Golden drop, 40 bushels.

The above were grown after peas, which is considered a bad preparation for wheat.

In Worcestershire, a crop of wheat, in 1843–4, was at the rate of 45 bushels to the acre; and as much was expected the succeeding season. It was of a kind called Burletta wheat, and was sown by drill at the rate of two bushels per acre.

In another part of Worcestershire, in 1844–5, on 130 acres, the crop was nearly 47 bushels per acre, and the sample represented as excellent.

These are remarkable facts, and well worthy the attention of the farmers.

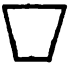
Wheat is sometimes grown here upon a summer or naked fallow, especially where the land is much infested with weeds; but naked fallows are well nigh exploded in any improved system of English husbandry. Wheat generally comes once in a four years' rotation; sometimes twice in five years, and in some cases twice in seven years; in some every alternate year, beans forming the intermediate crop. The latter course, for sixteen years, has been the practice of an eminent farmer in Norfolk, whose admirably-managed farm I had the pleasure of visiting. The land subjected to this treatment is a deep rich alluvion, formed from the deposits under the sea, and the beans are most thoroughly manured.

The preparation of the land for wheat is made with extraordinary pains. The crop preceding it is usually turnips, or some green esculent, which is consumed by sheep upon the land. The turnips are of course most amply manured, and are generally cultivated in drills. When the season for sowing wheat arrives, these drills are opened by the plough, and the decomposed manure very thoroughly distributed. It is considered bad husbandry to apply green manure, or manure of any kind, excepting from the folding of sheep upon it, to the land, the year the wheat is to be sown; but the result is always better, when the sheep so folded, besides the turnips or other green feed with which they are supplied, are liberally furnished with oil cake. One of the most skilful farmers in Lincolnshire, who, by a successful husbandry, has risen from small beginnings to wealth, and has established in comfort several sons upon farms in his vicinity, ascribes his success wholly to the liberal use of oil cake for his stock, considering it of the highest value in enriching his manure. I had the pleasure of witnessing the most ample evidences of his good husbandry. This system of enriching land by folding sheep upon it in movable folds — a custom long known in England — might in many instances be adopted in the Northern United States, especially when the market for mutton is improved. This, I think — after carefully watching its progress for some years past — it is destined to be; especially when our breeds of sheep, grown for this express object, are improved. Here mutton may be considered as the favorite dish with all classes who consume meat, and is the principal meat to be found in the markets, where it is exhibited in extraordinary perfection.

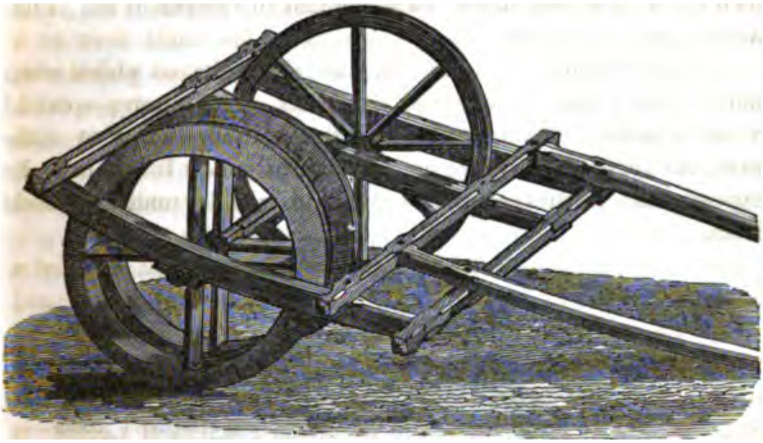
The soil preferred for wheat is a strong soil, with a large proportion of clay; but experience has, of late years, contrary to early and strong prejudices, determined that even the light and loamy soils are capable of bearing heavy crops of wheat, provided they can be sufficiently consolidated. This is done often by driving sheep over the land after sowing, and by an implement which I shall presently describe, called a *presser*.

The first process is, thoroughly to clean the land from weeds and rubbish; but the green crop previously cultivated, if it has been properly managed, will have done much towards this. The twitch grass (*triticum repens*) abounds in the lands here to a most extraordinary extent, and this is raked out and pulled out, and generally piled on the land and burnt, and the ashes spread. Some persons adopt the method of mixing the piles of it with quicklime, and thus forming an enriching compost for their land. Others carry it into their barn-yard, to be trodden under the feet of the cattle, and to absorb the liquid of the yard.

But wheat is often sown after clover, or upon what is called a clover lay; the first crop in the course being turnips, the second barley, the third clover; if cut the first year for hay, then depastured with sheep the second; or otherwise fed and ploughed in, and the wheat sown on the inverted sward, and the land not harrowed so deeply as to tear it to pieces. When the clover is designed to stand only one year, it is mowed and made into hay in June, and then sheep are folded upon it; and in this way they go over the field twice before it is ploughed for sowing. It is deemed of great importance, in this case, that the soil should be in as compact a state as possible, and a heavy roller is passed over it. The greatest stress is laid upon this matter of consolidating the soil, where it is of a light or spongy character; and in some soils the ground is simply harrowed, where the preceding crop allows of such a process, or otherwise ploughed not more than three or four inches in depth.

An instrument much used for consolidating the soil, and very much approved of by those who use it, is called a *seam-presser*. This implement passes over the land in the direction of the furrow, and it forms on the furrows two deep drills at a time, the two rollers being eight or nine inches apart, and the blade of the roller, if so it may be called, or the rim, being thin at the edge, and growing wider above the edge, thus, , and forming, as it revolves, two furrows, hardened by its weight, into which the grain drops as it is sown; and when it comes up, it appears as if it had been regularly sown in drills of eight or nine inches apart, according to the width of the revolving presses from each other. "The seam-presser is, in fact, an abstract of a drill-roller, consisting of but two cylinders of cast iron, which, following the plough in the furrows, press and roll down the newly turned-up earth."

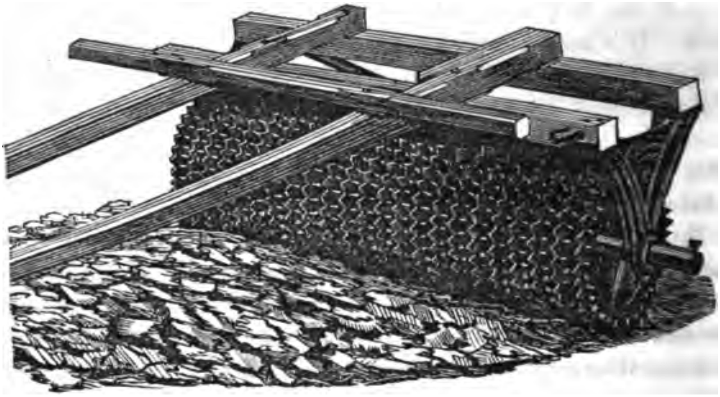
Seam-Presser.



On heavy or clay soils much more work is rendered necessary to bring them into condition. The first of all requisites is, that the land should be thoroughly drained or freed from wet. In all cases of heavy land, it has been the custom to throw the field up into beds, or, as they are here called, *stitches*, with an open furrow between them. In many cases which I have seen, these are even less than six feet wide; and wherever they are made by every sixth furrow or every eighth furrow, it is obvious that every acre in six, or every acre in eight, is lost; for nothing grows in the intermediate drains. The practice of cultivating in beds or stitches is, I may say, almost universal throughout England and Scotland; in general, however, these beds are from three to six yards wide; on dry lands, more than this. Since the introduction of the Deanston system of thorough-draining and subsoiling, it has been shown that they are not at all necessary for carrying off the wetness of the land; and that on a perfectly flat surface, which has been drained and subsoiled in an effectual manner, all the water falling upon the surface, will, by a direct descent into the ground, find its way to the drains. In this way the loss of land is prevented, and the condition of the land over the field is more equal; for the practice of forming beds or stitches by continually turning the furrow towards the centre of the ridge, is to rob the part of the land nearest the furrow; and the plants growing near the margin of the furrows are always inferior to those upon the centre of the ridge. Under these circumstances, the only consideration upon which these stitches can be recommended is, that they assist the sower and the reaper in the measurement of their work.

Another instrument is used on hard clay soils, — which often remain after ploughing, and even harrowing, quite lumpy, — called a *clod-crusher*, which not only reduces these lumps to fineness, but serves likewise to consolidate the soil. It can only be applied with advantage where the lands are dry and the clods hard.

Crosskill's Patent Clod-Crusher.



" *Clod-Crusher.* — This valuable implement is composed of a series of iron rings, with notched edges set apart from each other about three or four inches. Small crossbars, or knives, are placed at frequent intervals on the faces of these, and near their outer notched rims, so as to intersect every portion of land over which it passes. Its construction, combined with its great weight, renders it very effective for the purpose which its name denotes. It has been aptly said to be 'a roll and a harrow combined.' Its use has been found to prevent the ravages of the wire-worm — no small recommendation to it."

"Further improvements have been made in its construction, the principal features of which consist in an improved form of tooth, for breaking, rather than grinding, the clods; and in arranging for each cylinder independently to revolve upon its own axis — an advantage which not only increases its efficiency, but materially lessens the power required for its draught."

"The roller is an implement which requires more than usual judgment as to the time of its use; and this remark applies with increased force to the one under consideration."

Perhaps there is no agricultural implement in use in England, at the present time, save only a plough, that is so much approved of by practical farmers as this clod-crusher. It is used sometimes before sowing, to get the land into condition and produce a fine tilth. It is used, likewise, after the plant has come up, to consolidate the land and fix the roots of the plant; and it is used also with much advantage on the wheat, in the spring. It has proved of very great efficacy in the destruction of the wire-worm, frequently at once arresting its ravages in a wheat field. It is used likewise with great advantage upon light soils, in consolidating them, and as a substitute for the treading of the wheat-ground by sheep; for which purpose, when they are used, it is considered, in most cases, very much to their injury. The implement is heavy, and is generally drawn by three horses.

The quantity of seed to be sown has been matter of much discussion and experiment. The amount, with different farmers, varies from three pecks to three bushels per acre; and some persons contend for four and even five bushels. The saving of two, or even of one, bushel of seed per acre, upon the whole extent of land cultivated throughout the kingdom, would be indeed an immense saving. The saving in seed of two bushels, to a farmer who cultivates his fifty or his hundred acres of wheat, would certainly deserve much consideration; but if this saving is to be made at the loss or diminished product of three or five bushels in the crop, it would prove a kind of economy not much to be commended. Among the various conflicting statements which have been made to me on this subject, and which have been publicly reported, it is exceedingly difficult to arrive at any satisfactory conclusion. A very eminent Scotch farmer, of large experience, says that, "in some seasons, a moderately thin plant — that is to say, a small number of the young plants of wheat standing upon a given space of ground — is found to be advantageous both to quantity and quality of grain, and in others highly injurious."

Mr. Davis, of Crogden, to whom I have before referred, claims, from a sowing of three pecks to the acre, to produce an average crop of forty bushels to the acre. The last season, on visiting his farm, though the straw was of a very large size, and the heads long and full, it seemed to me impossible that it should have produced even thirty bushels per acre; and much of it was certainly extremely foul with weeds. I regret that, though I have attempted, I have been unable to ascertain the actual yield; and I am quite ready to admit that one is very liable to err in judgment upon such a crop, not making proper allowance for the length of the heads, which was quite remarkable.

The experiments of Mr. Barclay, M. P., given in the 6th volume of the Journal of the Agricultural Society, seem to go strongly against the thin sowing of wheat.

2½	bushels	of	seed	drilled,	9	in.	apart,	gave	37	bushels	per	acre.
1	"	"	"	"	12	"	"	"	25	"	"	"
1	"	"	"	dibbled,	12	"	"	"	31	"	"	"
1¾	"	"	"	"	9	"	"	"	37	"	"	"
2½	"	"	"	sown broadcast,	.	.		"	40	"	"	"

The value of the grain, as estimated by the miller, was 3 d. more per bushel, in the first and last case, than in the others, and the straw, in the last case, was considerably more, in quantity and value, than in either of the former.

In an experiment which I myself saw upon a very small scale, wheat, dibbled at the rate of six quarts to the acre, produced at the rate of seventy bushels to the acre.

In some experiments reported by W. Miles, Esq., M. P., made at his beautiful farm at King's Weston, near Bristol, the yield of the drilled wheats, at two bushels, and one bushel three pecks, per acre, was very much superior to those dibbled at two pecks and one quart per acre.

The wheats produced as follows: —

Drilled Wheats.

No.	Quantity of Seed per Acre.	Product in Good Wheat.	Product in Tail or Imperfect Wheat.
1.	2 bushels.	48 bushels 6 pecks.	7 bushels 2 pecks.
2.	2 "	42 " 2 "	4 " 0 "
3.	2 "	47 " 0 "	7 " 1 "
4.	2 "	35 " 3 "	4 " 3 "
5.	2 "	49 " 0 "	5 " 0 "
6.	1¾ "	34 " 2 "	2 " 2 "

Dibbled Wheats.

No.	Quantity of Seed per Acre.	Product in Good Wheat.	Product in Tail or Imperfect Wheat.
1.	2 pecks.	21 bushels 3 pecks.	3 bushels 0 pecks.
2.	2 " 1 qt.	30 " 2 "	4 " 1 "
3.	2 " 1 "	19 " 1 "	2 " 3 "
4.	2 " 1 "	34 " 1 "	6 " 1 "

Mr. Miles's remarks, subjoined to this statement, are well worth repeating.

"Notwithstanding the dibbling in this trial must be considered, as far as regards Nos. 2 and 4, a failure, yet I cannot but state my thorough conviction, that upon light, flat land, free from stones, this system ought to be universally adopted. I should, however, recommend not less than a bushel to be dibbled to an acre, and that the process should take place earlier in the season, as when, from the quantity of grain grown, there cannot be a superabundance of plant, it is of great moment that it should be fully established before the alternations of frost and thaw commence. The tillering of the plants is extraordinary, as well as the strength of the straw; and what is saved in seed may be most beneficially applied to keeping the land perfectly clean, with advantage to the laborer and certain profit to the cultivator. If, indeed, we take two instances of the same species of corn from the above tabular results, we cannot fail to be struck with the much greater return from the small than from the large quantity sown; for instance, I find that No. 2, drilled at two bushels per acre, produced forty-six bushels two pecks; whilst No. 1, dibbled at two pecks per acre, gave — say, twenty-five bushels per acre. Two pecks of seed, however, were only tried in the latter, whilst four times that quantity was used in the former case; proportionally, therefore, instead of forty-six bushels two pecks, it should have given one hundred bushels. I throw out these hints for serious consideration, as, without doubt, such a saving of seed as the general introduction of the dibbling machine would produce must be esteemed of national importance."

These are, certainly, very remarkable results; yet Mr. Miles gives, in the same paper, an account from a book of husbandry written some years since, in which an experiment is detailed of sowing ten pounds to the acre, and twenty pounds to the acre, in which the advantage appears to have been greatly in favor of the thin sowing. In Mr. Miles's case, a good many of the wheat plants were destroyed by the frost. In the thickly-sown, a loss could be afforded, as a sufficiency of plants would remain for a crop; in the thinly-dibbled wheats, there was no such reserve to fall back upon, and the loss was fatal.

In this matter, many things are to be considered. Some kinds of wheat tiller much more than others; that is, a single plant of one kind of wheat will throw out more shoots than a plant of another kind. The time of sowing is a material point. The earlier sown wheat has much more time to thicken, and throw out bearing shoots, than late sown wheats. The condition of the land, likewise, is to be considered. Highly-enriched and manured land will nourish more plants than that which is poor and scantily manured. The state of the land, in the next place, as it respects weeds, must be taken into view. On land which is foul, thin sowing will give an opportunity for the weeds to spread themselves, very much to the disadvantage of the crop.

I have already treated this subject, to some extent, in my second report, to which I must refer my readers. I cannot help thinking that, with early sowing upon well-manured and well-cleaned land, and the faithful hoeing of the crop, so as to keep it free from weeds, a much less quantity of seed than what is usually applied might be safely and strongly recommended. But, as these favorable circumstances cannot always be secured, certainly, in ordinary cases, a liberal allowance of seed is to be advised. The only saving to be calculated upon, in this matter, is in the quantity of seed; as it does not appear, from any experiments which have been reported, or which have come under my notice, that the crop has, in any case, been lessened by too much seed.

This subject is, certainly, one of great importance. The farmer, who has most strongly advocated thin sowing, or a great reduction of the usual quantity of seed, from a letter which I have recently received from him, remains confident of the soundness of his views. On the other hand, the opinion of another eminent practical farmer is, "that these new doctrines are calculated to do greater and more extensive mischief, not only to the growers but to the consumers of corn, than any other theory he ever remembered to have been broached."

In some experiments given in the able report on Norfolk farming, in the Royal Society's Journal, it appears that wheat sown at the rate of ten and a half pecks per acre produced nearly two bushels per acre more when sown in 7 inch than when sown in 9 inch drills. In another case, there were three and a half bushels in favor of the 7 inches. In another case, wheat drilled at 4½ inches exceeded 9 inches by nearly two bushels, and 7 inches exceeded 9 by eleven pecks and three pints.

In another experiment,

8 pks. seed produced more than 7½ pks. by 5 pks. 14 pts. per acre.
9 " " " " " " " " 6 " 9 " " "
10 " " " " " " " " 7 " 4 " " "
11½ " " " " " " " " 12 " 6 " " "
12½ " " " " " " " " 14 " 12 " " "

These statements do not determine the case, but they are strongly entitled to consideration. It would be wrong, however, not to state that, in a subsequent experiment of this same farmer, the difference between sowing eight pecks or twelve pecks, after deducting the seed, was only a few quarts. Thus,

8 pks. of seed produced at the rate of 39 bushels 2 pks. 2 qts.
12 " " " " " " " " 40 "

And in another case, three bushels of seed actually produced less than two bushels and a peck. Thus,

9 pecks of seed produced 40 bushels 2 pecks 2 quarts.
12 " " " " 40 "

It is admitted that crops standing thickly ripen the soonest; and the grain produced by them is said to be of a superior quality to that which comes from thinly-sowed crops.

On Lord Leicester's estate, in Norfolk, (who, more than any other man in the annals of English agriculture, distinguished himself for his successful husbandry,) the practice was to sow three bushels per acre. On Mr. Dixon's farm, in Kent, whose crops are said to average forty-two bushels per acre, the custom is to sow two and a half, and sometimes nearly three, bushels per acre.

The time of sowing wheat in England admits of a long range, from the middle of September until December, and sometimes even into February. Where circumstances favor it, an early sowing is preferred; and very forward wheats are fed down, in the spring, by sheep, which are folded upon them. In cases where a crop, to be followed by wheat, is to be used upon the ground, the wheat is not sowed until that crop is fed off; or where wheat follows potatoes, the sowing is carried forward far into the season.

Wheat follows turnips, mangel-wurzel, carrots, potatoes, and clover. The last is universally approved. Mustard is likewise sown, as a preparation for wheat, sometimes at the rate of seven, and sometimes at the rate of sixteen, pounds to the acre, to be fed off by sheep, or otherwise to be covered in as a green dressing. A matter is stated as a fact in this case, which deserves attention; that the white mustard will not remain in the soil after being once ploughed up; that the black can hardly be eradicated, but has been known to remain in the soil for ages. We must be cautious what guests we entertain.

I have already said that, in a rotation of crops, only one out of the four is manured, and that green barn manure is never applied to the wheat crops. But the wheat crop cannot be said to be not manured, for the folding of sheep upon the ground, by their consumption of the green crops, furnishes a most effectual manuring. Besides this, artificial or saline manures are applied to the crop, and guano has been used with great success. The nitrates have mainly served to increase the amount of straw, but not of grain; and although some experiments seem to have produced a great increase of grain from their use, yet they are not very often applied. I have, however, the assurance of one extensive farmer of his success in the use of the nitrate of soda when applied to oats upon a clay soil, increasing the crop in the proportion of 12 to 5, and this in repeated trials. I regret that I could obtain from him no further and no more exact particulars. There are many instances given, and some from farmers with whom I have the pleasure of an acquaintance, of the very successful application of nitrate of soda to wheat; yet, in spite of these, it is not very extensively used, and its application is viewed with great distrust. Further, and more exact, and longer-continued experiments are greatly to be desired.*

There are three modes of sowing wheat — the first, broadcast; the second, by drilling; the third, by dibbling. The last two methods are generally done by machines; the last not always, however; unless women and children, who drop the grains in the hole made by a dibble of the most simple construction, are to be considered as machines, and the human hand the most perfect of its parts. Drilling and dibbling are methods certainly to be preferred, as the seed is more evenly sown, and an opportunity is offered of hoeing and weeding the crop, which is here most carefully done, and undoubtedly to great advantage. When wheat is drilled, likewise, there is an opportunity of cultivating between the rows by implements for that purpose, the advantages of which are unquestionable. These implements are denominated *horse-hoes*, or *scufflers*.

In my next Report, I shall give a plate of a horse-hoe much in use; but I cannot, among the many varieties exhibited, pronounce it the best. I shall give it as a specimen of the implements used here, thinking, if it has no other benefit, it may furnish some useful suggestions to some of our inventive manufacturers of agricultural tools, who, in the ingenuity and skill of their productions, and especially in the excellence of the workmanship, (and it is no disparagement to the English manufacturers for me to say it,) need not fear a competition with the best mechanics on this side of the water. The implement has received the highest premium of the Agricultural Society, with very strong commendations.

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* "With regard to nitrate of soda, from which so much was once expected, there are the most undoubted proofs, from numerous quarters, of an enormous increase of the produce after its use; there are as undoubted instances of its utter failure. Nor have we any clew to the mystery. On the same land, where it gave me eight bushels one year, it gave barely three in the following; and having tried it largely, at that time, on different farms, nowhere with success, I have given it up. Still, there is evidently a principle of fertility in it, which will some day be found out; and some farmers continue to use it; but in several cases it has produced mildew in wheat and barley, by forcing the crop beyond the strength of the land. By the side of the nitrate, I tried, on several fields, the sulphate of ammonia, extracted from gas-water the first time. It acted precisely as the nitrate of soda, darkening the color of the plant, and strengthening the straw and the ear even more than the nitrate; but it certainly did not pay. Again, we have the principle, and we must learn to combine it." — *P. Pusey*, Esq., M. P.

A Leicester Ram.

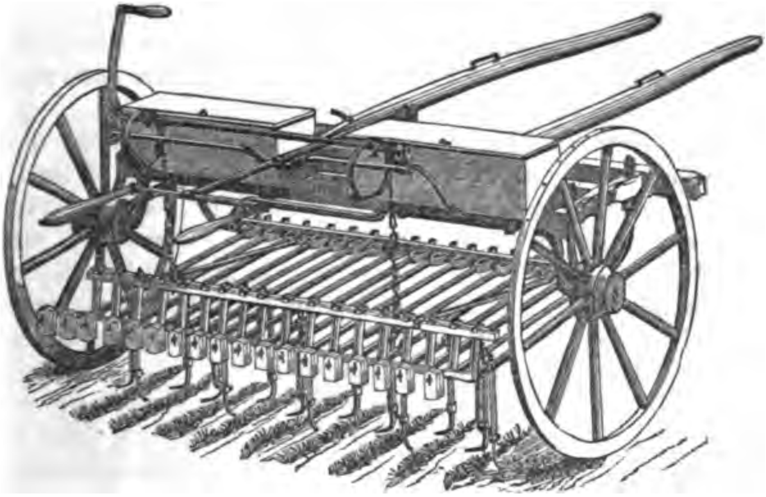
Bred by & the Property of Mr. Saml. Bennett of Bickerings Park, Bedfordshire, which obtained the first prize of £30 at the Meeting of the R.A.S. at Cambridge July 1840.

EUROPEAN AGRICULTURE.

EIGHTH REPORT.

CVI.—CROPS. (*Continued.*)

Garrett's Patent Horse-Hoe.



"THIS horse-hoe, invented by Garrett and Son, of Leiston, is suited to all methods of drill cultivation, whether broad, stetch, or ridge ploughing, and is adapted to hoeing grain of all kinds, as well as roots. The peculiar advantages of this implement are, that the width of the hoes may be increased or diminished, to suit all lands or methods of planting; the axletree being movable at both ends, either wheel may be expanded or contracted, so as always to be kept between the rows of plants.

"The shafts are readily altered and attached to any part of the frame, so that the horses may either walk in the furrow, or in any direction, to avoid injury to the crop.

"Each hoe, or each pair of hoes, works on a lever independent of the others; so that no part of the surface to be cut, however uneven, can escape; and in order to accommodate this implement to the consolidated earth of the wheat crop, and also the more loosened top of spring grain, roots, &c., the hoes are pressed in by different weights being hung upon the ends of each lever, and adjusted by keys or chains, to prevent their going beyond the proper depth.

"That which has hitherto been an objection to the general use of the horse-hoe, in this is avoided by adopting a mode of readily shifting the hoes, on a plan similar to that of the steerage adopted in drills, so that the hoes may be guided to the greatest nicety. This implement is so constructed that the hoes may be set to a width varying from seven inches to any wider space; the inverted hoes are preferred, when the distance between the rows is sufficient to admit a pair of them; otherwise, triangular or arrow-shaped hoes may be substituted, or any other form that may be considered best for the purpose.

"Two points in this hoe are worthy particular notice; the one being that the blades of the hoes are made entirely of steel, and are attached to the stalks so readily that, as they may become damaged or worn out, they may be replaced, by the operator, without difficulty; the other, that the position of the frame admits of easy adjustment, so that, according to the texture of the soil, the cutting edges of the hoes may assume a position more or less inclining to the work." *

Wheat is drilled when it is sown in a continuous line, and in general the distance of these drills or rows from each other is about nine inches. A greater width is preferred by some persons. When the ground is marked out by a seam-presser, as before described, the seed then comes up in continuous rows, as if it were sown by a drill-machine; but there are several machines in operation expressly for the drilling of wheat and for depositing, at the same time, in the drill, such fine manure as it may be desired to sow with the grain. Indeed, to such perfection have

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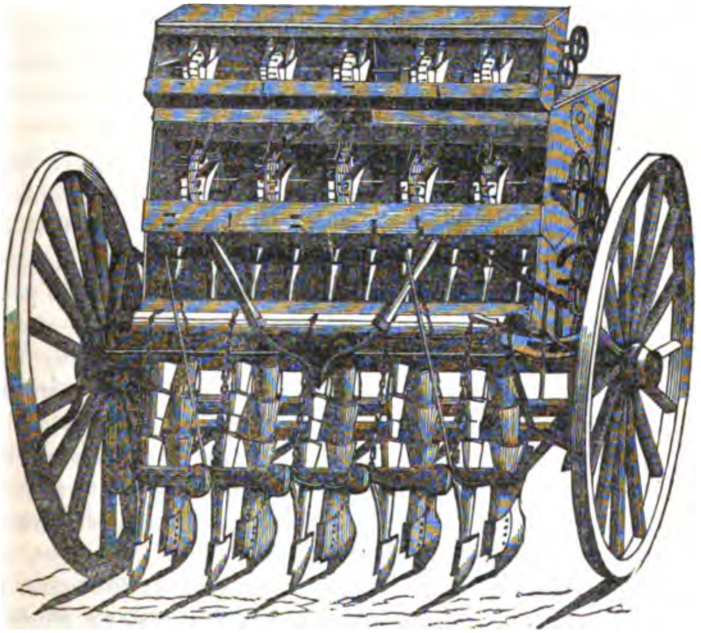
* Ransome's Implements of Agriculture.

some of these machines been carried, that even coarsely-chopped manure is likewise deposited by them in the row, as is done in the case of sowing turnips or other roots.

At first sight, these machines appear extremely complicated and unwieldy; and one would be inclined to think that a spinning jenny might be managed with equal ease in the field. They are cumbrous, and to a degree complicated; yet they are much in use, and they certainly perform their work extremely well. This, perhaps, is all that is to be asked of them; and mechanical ingenuity, which, under the stimulus of large premiums and a powerful competition, is now, every day, becoming more active, may presently succeed in rendering them more simple and light, without reducing their efficiency. I give below, merely as a specimen, the engraving of a drill machine to which the Agricultural Society awarded its premium of thirty pounds; it is said to have a deserved popularity. I have seen several different kinds in operation, but with very imperfect means of making a comparison between them; and, from a necessarily cursory observation, it would be presumptuous in me to

Garrett's Patent Drill for General Purposes.



pronounce a decision upon their merits. As every man, with a common endowment of philoprogenitiveness, deems his own children the handsomest; and, though they may be blear-eyed or bandy-legged, will come at last to look upon these defects and deformities with indulgence, or even with complacency and admiration, and will insist that others shall have the same opinion; so, if we take the accounts which the inventors and makers give of their own machines, we shall find the correspondent exaggerations of self-esteem and vanity, and shall be called upon to believe that each one supplies the defects, and surpasses the merits, of every other.

" The Suffolk drill is the kind in most general use throughout the kingdom, and is adapted for drilling corn either on level lands or on ridges, and on all descriptions of soil. It is furnished with *independent levers*, by which the colters are *each* readily and separately made to avoid any rocks or irregularities of the ground, and a press-bar, extending over the entire width of the machine, to force the colters, in case of need, into hard ground, with a varying degree of pressure, according to the texture of the soil.

" The colters can be set so as to drill the corn at any width, from four inches to a greater distance. They also, if required, readily allow of the introduction of the horse-hoe; and, from being placed in double rows, they admit, when at work, large stones to pass between them, of a size that, under the old plan of placing the colters in one line, would break or stop the machine. The most complete drills are furnished with the '*swing steerage*,' by which the drill-man keeps the rows at exact or even distances from those which have been previously drilled. The 'corn barrel' is made to deliver from two pecks to six or seven bushels of seed, per acre; and they are furnished with an additional barrel for drilling turnips and mangel-wurzel. These barrels, by a simple yet efficient 'regulator,' are kept, on unequal, hilly ground, at the same level; so that the grain is evenly delivered, in whatever situation the drill may be placed.

" A '*seed engine*' is also sometimes added to the common corn drill, by which the grass seeds and clover are sown at the same time as the corn, and each kind of seed, if required, separately. By this plan, any quantity, per acre, of the seeds may be much more evenly distributed than by mixing them up together. For these seeds, being of different sizes and weights, are, in the ordinary seed engines, very apt to separate in the boxes; and thus the brushes too often deliver them in unequal proportions.

"The weight of these drills necessarily varies with the number of colters, ranging from three to ten hundred weight; they are drawn, according to circumstances, by one, two, or three horses; the sliding axletree, allowing the addition of any number of colters, adapts the drill to different breadths of land.

"The manure-box may be taken on or off at pleasure. It is a simple yet accurately-working apparatus for delivering the manure, which it does with great evenness, and in quantities varying, as the 'slip' is placed, from six to eight bushels per acre. In the best drills, also, a very important improvement has been made within the last few years, which consists in the use of separate colters for manure and seed. The manure is now deposited, according to the mode preferred by the cultivator, not only from two to three inches deeper in the ground than the seed, but from ten to twelve inches in advance of it, so as to give the soil time to cover the manure before the next colters deposit the seed; whereas, on the old plan, of depositing the seed and the fertilizer together down one pipe, an evil was liable to arise; when it was used with some of the more powerful artificial manures, the seed and the manure were too close together, and the manure was not dropped with certainty in its best position, *under* the seed." *

At the Shrewsbury meeting of the Royal Agricultural Society, a drill, or seed-depositing machine, was exhibited, of which the approbation of the judges of implements is so emphatical that I shall quote it in full. It was the invention of Mr. William E. Vingoe, of Penzance, Cornwall.

"This implement enlisted the judges' earnest attention and unqualified admiration, from the simplicity of its acting parts, the accuracy of its deposition of seed, and the mechanically-good adaptation of means to ends. Although simple, it is difficult to describe. It travels on three wheels, the leading pair being attached to the shafts, from which pair is derived the small power required to effect the measurement and deposition of the seed. The machine is capable of sowing six rows of corn, (grain,) or other seed, at a time. The apparatus for forming the drills consists of six pressing wheels, immediately followed by as many narrow boxes or shares, which maintain the little trenches clean and open, and each trench perfectly distinct, until the seed falls into them. Through these shares, the seed is conducted by small tubes from the seed-box or hopper above them; and immediately behind the shares is placed a peculiarly-simple and effective kind of hoe, for covering the seed. The seed is received upon sliders resting upon the bottom of the hopper, and furnished with proper recipient holes, the size of which determines the number of seeds desired to be planted. Means are provided for striking off excess; and it was found, on repeated trials, that no greater difference took place, in the number of seeds deposited, than was fairly attributable to the difference in the magnitude of the corns. The entire apparatus is readily raised out of the ground at headlands, or when turning. If the preparation of a firm seed-bed be a good principle, this machine effects it as well as any presser; pressing and drilling six rows at once, with an adjustment for shifting the width of the rows from five to any other number of inches apart desirable for grain; and it either distributes the seed in a train or drops it within a small compass." *

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* Ransome's Implements of Agriculture.

Such a machine as this would seem to meet its objects perfectly; but there are many others, which claim for themselves equal advantages. It would be idle to attempt to enumerate the various forms of drill machines which I have seen at work in the country, and to the value of which I can bear a strong testimony, not so much from an inspection of the construction of the machine as the excellent manner in which, so frequently, the work appears to be executed. The practice of drilling wheat is in my opinion greatly to be preferred to that of sowing wheat broadcast; first, in the much more equal distribution of the seed; next, in the better opportunity which the wheat has of spreading or tillering; and thirdly, in the opportunity of clearing and cultivating the crop, which latter is of great importance. I am of an opinion, borne out very strongly by facts which have come under my observation, that wheat in the early periods of its growth is as much benefited by cultivation as any plant which

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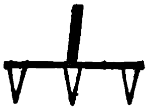
* Report of Committee on Implements, at Shrewsbury, 1845.

is grown; and the injury which is done, both to the growth of the plant and to the sample of grain, by the weeds which ripen their seeds among it, renders the weeding or clearing of the crop of great importance. This is often done here, even when the crop is sown broadcast; and it is not uncommon, in the spring, to see a large party of women in a field, employed in weeding; but it is obvious to what disadvantage this is done when the plant is sown broadcast, compared with it when sown in drills.

The next mode of planting wheat is by dibbling. Drilling is sowing the wheat in rows, in continuous lines; dibbling is planting it, in these rows, at intervals, sometimes, of six inches to a foot. This is sometimes done by hand: a laborer goes forward, with an instrument with two or three teeth, making holes, into which children, who follow him, drop one or more seeds as they go on, and cover them with their hands or feet. Labor is here so abundant, and parents, in order to eke out their narrow means of living, are so ready to avail themselves of the labor of their children, that this operation is not expensive, and indeed is often compensated by the actual saving in seed; and abating the irregularities in the sowing, which may be expected from the common recklessness of children, may be considered as a good mode of executing the work. But machines have been invented for dibbling as well as for drilling; and one called *Newberry's machine*, from the name of its maker, is exceedingly ingenious in its construction. I should find it difficult to describe it intelligibly. A machine calculated to sow only one row has one wheel, to sow five rows has five concentric wheels, hollow, and with a box in them to contain the seed, with dibbled points upon the rim of these wheels, at such distances as it is desired the holes should be made. As the machine revolves, these dibbles or pins, which are in fact hollow, force themselves into the ground, making a place or hole for the deposit of the seed; and, as they are being raised from the hole, they divide and drop the seeds into it, which is covered and pressed down by the machine. The machine is calculated to sow from four to five pecks an acre. It is drawn by two horses, — in some cases more are required, — and in general performs its work well. It is an expensive machine;



and its weight has been objected to by many persons; but by some farmers this, on light lands, is considered an advantage.

There are several other kinds of dibbling machines, which I need not describe, and, among others, a machine carried in the laborer's hand, which makes the hole and drops the seed by the same operation. It is ingenious, but is adapted to cultivation only on a very small scale.

On one of the best cultivated farms in England, — that of the Duke of Bedford, at Woburn, — Mr. Bumers, the farm manager, states (1845) that he employed boys to dibble one hundred acres of wheat. The holes were made with a stick or dibble, three inches asunder in the row, the distance between the rows being nine inches; and the number of "dibs," per acre, amounted to 232,320. He states that he has some boys who would make one hundred and fifty-one holes in a minute; but of course they could not long continue such a rate.*

A great diversity of opinion prevails on the subject of drilling and dibbling wheat; and, from the respectability of the differing parties, there is reason to believe these different opinions are held in equally good faith. The invention of a patent machine for any particular object, like that of a patent medicine, always develops in the artist or inventor a wonderful facility in procuring authorities in its favor. The advantage of being able to weed and cultivate the plant applies even more to wheat which is dibbled than to that which is drilled, and the product is likely to be as good. In all these cases, the main saving calculated upon is in the quantity of seed to be sown. This may vary from one bushel and a peck to two bushels and upwards per acre. This is, certainly, where any large quantity is to be sown, an important consideration. Where the land is in good condition, enriched and free from weeds, and where the planting can be done very early in the season, and carefully done, dibbling may be considered safe, and perhaps to be preferred; but, in all cases, against the advantages of dibbling a small quantity of seed, are to be set off the danger from insects and frost, and the imperfect germination of the seed. To save two bushels, or even one, per acre, in all the seed sown throughout the kingdom, would be an enormous saving, and come very near meeting all the demands which are made for foreign supplies; but on the other hand, from the omission to sow sufficient seed, to experience a loss or deficiency of four or more bushels per acre, as some pretend would be the result, would be a much more serious matter. I have known a good many persons to hold to some particular opinions or faith in religion, because they say, notwithstanding their conviction of their inconsistency or absurdity, if they should prove wrong they still would be safe; whereas, if they adopted other opinions, to which they feel strongly inclined, and of which they perceive the reasonableness, if they should not prove true, they would find themselves in an unfortunate condition. The state of opinion, in regard to the thick or thin sowing of wheat, is quite analogous. Farmers may be safe, and save their seed, by sowing little. They do not save their seed, but they are sure to be safe, — so far as this goes, — in regard to a crop, by sowing a good deal. Different minds will view the matter differently; but, having fully stated the case, like a wise judge, I submit it to those whose province it is to decide. I have known a great many persons, who have enjoyed an extravagant reputation for wisdom, who never gave a decisive and unequivocal opinion in any case. Like the Delphic oracle, they were always sure to be right, because the prediction would fit any result. Without any pretensions to wisdom, it may be safe in me to adopt the same course.

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* On this excellent and admirably-managed estate, I found that thirty boys were constantly employed in farm work, for which they received sixpence per day. Their wages were never raised, but whenever they could improve their condition, they were at liberty to avail themselves of the opportunity. They were thus furnished with regular work, and were serving an apprenticeship to agriculture under the most favorable circumstances. This was real and most judicious philanthropy. This may not be understood on the other side of the water, where there is an urgent demand for all the labor that can be supplied; but it will be appreciated here, where employment, at any rate, is often very difficult to be procured.

The increase which, by painstaking, may be obtained from a single seed is very remarkable. I have already spoken of some instances, but I shall refer to others, for two reasons; first, for the curiosity of the fact, and showing how prolific, under good cultivation, a plant may become; and next, as evincing with how little difficulty a new and improved variety of grain may be obtained, by selecting from a field even a single head.

A farmer in Cambridgeshire, in 1840, gathered, from one of his fields, eighteen very fine ears of wheat, (which were five, six, and seven set,) the proceeds of which filled a common wine-glass. The above was planted the following autumn, and produced one peck, which was planted November 8, 1841, and produced seven bushels and one peck: planted the same, November 2, 1842; the produce one hundred and eight bushels and two pecks; which was planted in the autumn of 1843, and produced one thousand eight hundred and sixty-eight bushels. This was the increase from the eighteen ears, in the short space of four years.

We have another account of the product of a single ear, grown by an excellent and spirited farmer, Mr. Jonas, of Cambridgeshire.

In 1838, dibbled in 50 kernels, (30 of which only grew;)
product, 14¾ oz.
" 1839, " " 14¾ ounces; . . . . " 1¼ bushel.
" 1840, " " 1 bushel 1 peck; . . " 45 bushels.
" 1841, " " 45 bushels; . . . . " 537 "

A wheat in Scotland, known as the Hopetoun wheat, and deemed an excellent and prolific variety, owes its origin to the accidental circumstance of an observing farmer, Mr. Patrick Shirreff, having, in 1832, remarked a very superior ear, from which he picked out ninety-nine corns; and from their product came this celebrated variety. A similar origin is ascribed to the Chevalier barley, a popular and favorite variety, which sprung from an extraordinarily fine head, gathered from his fields by a gentleman of the name of Chevalier, and sedulously propagated. It is thus seen " what great effects from little causes spring," and how often an improved variety may be obtained, in the vegetable as well as in the animal creation, by a careful, repeated, and persevering selection.

The preparation of seed wheat, with a view to prevent smut, is by immersing it in brine sufficiently strong to bear an egg, and then sprinkling it with lime. Some persons recommend a solution of arsenic; but this is always attended with danger. An eminent farmer in Gloucestershire is of opinion that he always secures his crop against smut, by sowing newly-threshed seed, the produce of the preceding year. In his cultivation, he sows from three and a half to four bushels; his average crop is stated to be from twenty-eight to thirty bushels, and sometimes forty bushels, per acre. The depth of sowing is a point upon which all farmers are not agreed. Where the land is liable to be heaved by the frost, deep sowing of three and four inches is recommended; and in such cases, the wheat is often ploughed in, and the land left in a rough state, which is supposed better to shelter the plant. By the best farmers, great pains are taken in the selection of the seed-wheat. It was once held — and upon as high authority as that of Sir John Sinclair — that imperfectly ripened and scarcely merchantable wheat, since it would germinate, would answer equally well the purpose of sowing as the best formed and best ripened wheat. This was even recommended as being a saving of seed, since more kernels in number would be contained in a bushel of shrivelled or half-ripened wheat than in one of full and plump grain. This notion, however, is exploded; and wheat is understood to follow the universal rule, that, to produce the best, it is necessary to propagate from the best. Many farmers take pains, in selecting their seed, to take the best sheaves in their hands and strike them against some hard body, without threshing them either by machine or flail, thinking that, by this process, the fullest and ripest grains will drop out, which they save carefully for seed.

It is deemed of great advantage, in the spring, to drag or harrow the crop; or, where it is in drills, to scuffle it, as I have already described; or to hand-hoe and weed it, which, being light work, is generally done by women. I was about to say by *old* women; but I am not positive in that matter; for field-work, and poor clothing, and poor living, give an appearance of old age which is premature. Wheat is sometimes rolled in the spring before harrowing; and when far advanced in the autumn, it is sometimes fed down by sheep; the effect of which is supposed to be, to strengthen the stalk and to cause it to tiller or spread more.

The time of harvesting wheat has been matter of much discussion; but the results of repeated experiments, with a view to determine the best time, all point to an early rather than a late cutting. The best rule for harvesting is not merely when the stalk below the head has changed color, and the circulations have consequently ceased, but when the grain, though it has ceased to yield any milk upon pressure, is yet soft. It then ripens well in the sheaf; it yields more and better flour; and none is lost by shaking out, as when it is suffered to stand until it has become dead-ripe. Some farmers recommend that the wheat should be cut seven days, others fourteen, before it would be perfectly ripe. I do not hold that the middle path is always the preferable course; but there may be an error, as my own experience satisfies me, in cutting grain too early, as well as in cutting too late. In one respect, the farmers here have a great advantage on their side, in the number of laborers they can, at any time, bring into the fields; so that the largest crops may be cut and gathered in a comparatively very short time.

Wheat here is seldom put in barns; it is generally made into stacks. Staddles are formed of wood, — in some cases the feet are of cast iron, — about eighteen inches or two feet in height; sometimes the frame is of iron as well as the feet. On these the grain is stacked with the most extraordinary neatness, and well thatched. In this way, it will keep any length of time. When placed on iron staddles, the stack is inaccessible to rats. In parts of Cambridgeshire where the stacks were placed upon the ground, I found them plastered with lime-mortar, about two feet from the ground up, and whitewashed, which was regarded as a preventive against vermin. The stacks, in general, are made round; but this is objected to in Norfolk county, where the stacks are made long, as being made at less expense and more conveniently removed, in parts, for threshing. The stacks, generally, are calculated to contain from eighty to one hundred bushels; but, in Lincolnshire, I found them of an immense size — at least twenty-two feet in height, and more than fifty feet in length. In Norfolk, I found stacks of grain more than seventy feet long, and surrounding the homestead like a vast encampment. On one farm in the Lothians, I counted sixty-seven staddles; and more than those were filled every year. Many of the large stacks which I saw were estimated to contain from eight hundred to one thousand bushels each. The neatness with which a skilful thatcher will form, and finish, and frequently ornament, his stacks, is surprisingly beautiful; and the conscious dignity with which one of these large farmers displays his magnificent stack-yard, and leads you about his premises, is sufficiently to be admired, and certainly not by me to be condemned. At the example farm at Whitfield, Gloucestershire, there was a small railroad from the stack-yard to the threshing-floor, by which the sheaves were very conveniently transported. The great advantage of stacking grain, over storing it in barns, is, that it is not so liable to injury from heat; but the thatcher's art is a matter of great skill and experience; and as long as wooden barns are erected among us at so small an expense, and with our off-hand modes of doing things, it can scarcely be expected that we shall have patience to adopt it. I can only add, that I know no agricultural picture more beautiful than a neat farm-house in the midst of a crowded and well-thatched stack-yard.

I was to have said something of the different kinds of wheat; but it would not be possible to find any universal or unanimous preference, as different kinds are popular in different localities. Hunter's wheat, in the Lothians, "may be considered the most extensively cultivated of any genuine or unmixed variety in Scotland." It takes its name from the person who first propagated it by selection; and it is said to have been cultivated on one farm more than sixty years. It weighs from sixty-four to sixty-five and a half pounds per bushel, and has produced at the rate of forty-six bushels to an English statute acre. It is a winter wheat.

Mr. Skirving, the eminent seedsman of Liverpool, writes to me that he considers the Chidham wheat as the best to cultivate. This is known in Scotland as the pearl wheat. The grain weighs about sixty-five pounds per bushel. "It is a prolific variety, a free grower, and tillers freely in the spring."

The Whittington wheat presents a very beautiful grain. It was here called a spring wheat, because it had been sown in February, and was mistaken for what is called a spring wheat in New England, and not sown there until April, when it universally failed. It is, however, a late wheat, and, with us, should certainly be sown in the autumn.

The Talavera wheat is an early wheat, and much valued. "The bread made from it," says Colonel Le Couteur, whose careful experiments on the cultivation of different kinds of wheat are well known to the agricultural public, "is incomparably the best that I have met with. It is light, very white, and preserves its moisture almost as long as bread made from spring wheat. It is, moreover, so sweet and well-flavored as to appear to some palates more like cake than ordinary bread." It has yielded at the rate of fifty-two bushels per acre, weighing sixty-one pounds per bushel. Under the cultivation of another farmer, it produced thirty-six bushels per acre. Its cultivation has, however, been abandoned in Scotland. It is not deemed sufficiently hardy for their cold and wet springs, and is complained of as not tillering freely.

The Egyptian wheat, with its compound head, — appearing as though several heads of wheat, with the longest in the centre, were brought together, — is sometimes cultivated; but its produce and quality are not such as to encourage the cultivation of it.

I might enumerate many other varieties which are cultivated here; but I have, in truth, seen none superior to kinds common in the United States, especially the white western wheats. Indeed, the bakers here, for the purpose of producing the finest bread and confectionary, prefer the best American flour; and it would be difficult, at any time, to find any superior to the best Howard Street, from Baltimore, the best Philadelphia, and the best Genesee flour.

The seed having been sown, every pains is taken to keep the ground entirely free from standing water or puddles, which are always hurtful to the plant; and where the land has not been thoroughly drained, furrows are run across the field, for the purpose of intercepting and carrying off any water which might otherwise stand upon it.

Where wheat is to be followed by grass, or, as it is here termed, by *seeds*, clover and Italian rye grass are sown in the spring and harrowed in. Wheat sometimes follows potatoes; but this is not generally approved. It often follows clover which has been mowed or depastured, and then ploughed and rolled and harrowed, and the seed sown on the inverted sward without disturbing it. This practice is much commended. Some farmers have found an advantage in sowing white mustard, and either feeding it off by sheep folded upon it, or ploughing it under, in a state of succulency, as a green dressing for the land. About twelve or sixteen pounds, in such case, are sowed to an acre. A case is stated where the farmer, after ploughing in a crop of white mustard, obtained six or eight bushels more of wheat, per acre, than from land which was manured with rape cake. The land in this case, as I understand, was not manured for the mustard. The land is usually manured for mustard with seven or eight loads of manure per acre. The mustard is considered as a great preventive of wire-worms.*

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* Almack's Report of Agriculture of Norfolk.

I particularly refer to this practice, for the purpose of bringing before my readers an account of the experiment of John Keely, of Massachusetts, illustrating the beneficial effects of ploughing in a green crop as a preparation for a grain crop. To some of my readers, I am aware, it will be familiar, as I published it, some years since, in my first report of the Agriculture of Massachusetts; but I must claim their indulgence, on account of other of my readers, on both sides of the water, to whom it may not be known, as the experiment seems to me of great importance, and directly bearing upon the subject which I am now treating. I shall abridge it as much as possible.

"The land on which this experiment was made lies on the Merrimack River. The soil is a sand, approaching to loam as it recedes from the river. It is altogether too light for grass. Oats might probably be raised upon it to advantage, were it not that the land is completely filled with the weed commonly called *charlock*, (wild mustard,) which renders it unfit for any spring crop, excepting such as can be hoed. The crops of rye, on the neighboring soil of the same nature, vary from seven or eight to twelve or thirteen bushels per acre, according to the cultivation and their nearness to the river.

"In the summer of 1827, we sowed three bushels of winter rye, near the river, on about two acres of land, which produced twenty-eight bushels. In 1828, we sowed four bushels on four acres, running the whole extent of the plain from the river. This piece was sowed in the spring with oats, but they were completely smothered with charlock; and about the middle of June, the whole crop was mowed, to prevent the charlock seeding. By the middle of August, a second crop of charlock having covered the land, it was ploughed very carefully, in order completely to bury the charlock, and then suffered to remain until the 15th of September, when we began sowing the rye in the following manner: A strip of land about twelve yards wide was ploughed very evenly, to prevent deep gutters between the furrows, and the seed immediately sowed upon the furrow and harrowed in; then another strip of the same width; and so on, until the whole was finished. We found the oat-stubble and charlock entirely rotted, and the land appeared as if it had been well manured, though none had been applied to this part, since it had been in our possession. The rye sprung up very quickly and vigorously, having evidently derived great benefit from being sown, and having sprouted, before the moisture supplied by the decaying vegetable matter in the soil had evaporated to any considerable extent. This crop produced one hundred and thirty-three bushels.

"In 1829, the charlock was suffered to grow on the land appropriated to rye, until it had attained its growth, and was in full blossom. The land was then ploughed, and the charlock completely covered in. In a short time, a second crop appeared, more vigorous than the first. As soon as this had attained its growth, it was ploughed in as before. A third crop appeared, which was covered in when the land was ploughed for sowing, about the middle of September. This piece of land was a strip parallel with the other, and contained two acres. The crop produced seventy-four bushels and a half.

"In 1830, the land appropriated to rye included nearly all the lighter parts of the soil, and, owing to a pressure of business, was not attended to as we could have wished. It was ploughed, in the early part of the summer; but harrowing, to destroy the weeds, was substituted for the second ploughing. This, and the unusual blight which affected all the grain in this part of the country, led us to anticipate a small crop. It yielded fifteen bushels to the acre.

"The land on which the crop of rye was raised the present season had, for three or four years previous, been planted with Indian corn; and owing to the extent of our tillage land, we have not been able to apply more than four or five loads of manure to the acre this season. The charlock was suffered to attain its growth as usual, and on the 18th and 19th of June, it was carefully ploughed in. The second crop was ploughed in on the 6th and 7th of August. On the 14th and 15th of September, it was sowed in the usual manner; viz., a small strip of land was ploughed, and the seed sowed immediately upon the furrow, and then harrowed in. Then another strip of land was ploughed, and so on, until the whole was completed. One bushel per acre was sowed, as usual. Owing to the unusual severity of the winter, the crop was much injured, but recovered soon in the spring. The rye was reaped at the usual season. The land contained one acre and thirteen rods, and yielded forty-six bushels and three pecks — a remarkably fine sample."

This is certainly an extraordinary result. Mr. Keely remarks, that he "would not turn a furrow after the dew had evaporated. I have no doubt that a large portion of that fertilizing quality in the soil, which during the summer months is constantly exhaled from the earth, is by the dew brought again within our reach; and it would be wise to avail ourselves of the opportunity of again burying it in the soil.* In the second place, I would by all means use a heavy roller after each ploughing. It would fill all the cavities left by the plough, and, by pressing the soil more closely upon the weeds, would hasten their decomposition and much retard the evaporation from the soil." An eminent judge was advised, when he gave his decisions, never to give the reasons for them: his decisions might be right, but the reasons for such decisions might not be the true ones. Mr. Keely might have benefited by the same caution. His facts, without question, are as stated, but the causes which he assigns for the result may not be those which have produced it; yet the suggestions of such a man are entitled to consideration.

The harvesting in England is performed in three modes; by the sickle, by the common scythe, or by the Scotch bow or cradle. The sickle is fast yielding to the other instruments. The wheat is cut higher by it than by other modes, and there are therefore fewer weeds or foreign substances gathered among the straw, to fill the manure with pernicious seeds; and the straw, being clean, is not liable to be heated in the stack. But, if the seeds are not carried into the manure, they are left in the field, and in some cases with equal disadvantage. The grain being cut high, more straw is lost upon the ground; and reaping with the sickle is comparatively a slow process. Where the crop is much lodged, however, or matted, the sickle is almost indispensable. Mowing the grain with a common scythe is practised in many places. A skilful mower lays the grain with great precision, so that it is easily gathered and tied. The crop is, of course, cut very low, and the straw is much mixed. The Scotch bow, which is merely a hoop, extended upon the handle of the scythe so as to receive the grain in falling, that the workman may deposit it evenly for the binders, is much used, but, I may be allowed to say, is very inferior to the cradle, with its four or five fingers, in use in New England and New York.

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* It will be recollected that this is the opinion of a plain and practical farmer, some years before Liebig detected the presence of ammonia in rain-water.

The wheat being harvested and removed, it is customary to leave the field for the gleaners — the women and children of the vicinity. A farmer who does not do this, or who rakes his fields after the removal of the crop, usually renders himself obnoxious to the ill-will of his neighbors. This has now become, from long use, matter of prescriptive right. It is often, but not always, limited to the wives and children of the laborers in the service of the farmer. This privilege is worth more than one would at first be disposed to consider it, as a single expert gleaner will collect, in the season, three or four bushels. One woman assured me that she had sometimes obtained, by gleaning, to the amount of six bushels, in a year, of wheat; but I deemed this statement, as perhaps peculiar to the sex, a little poetical. Such results exemplify, in a striking manner, the extraordinary amounts of small savings; and if, as it is natural to suppose, they correspond to the accumulations of small expenditures, an experienced traveller or resident in England ceases to be surprised at them. The gleaners in a field, the women and children, from the peach-bloom of two years old to the sallowness and decrepitude of an old age withered by toil and want, present an interesting spectacle. I am not certain that this form of charity is unobjectionable; but it is gratifying to contemplate, when a benevolent farmer, by not suffering his reaped fields to be closely raked, himself shares in the pleasures of the gleaners' acquisitions, and thus strengthens the bonds of good-will and kindness which connect him with his humble dependents.

I have gone thus largely into the cultivation of wheat, because in England, and perhaps throughout the world, it must be considered, as a bread plant, the most important of all agricultural products. I myself believe, when all its uses and all the circumstances of its culture are considered, — what it requires and what it returns, — that Indian corn is more valuable; but it would be difficult to persuade others of this, who have not been brought up to its use. To the arable farmer here, and in the United States, where it can be grown, wheat must be the great object of attention.

I suppose there is no country where the average yield of wheat is so large as in England; and this product has nearly doubled within the last thirty or forty years. I am quite aware that, in many parts of England, the crops are still small, and do not exceed sixteen bushels to an acre; but on the estate of the late Mr. Coke, afterwards Lord Leicester, — where, when he came to reside on his property, it was thought, on account of the thinness and poverty of the soil, wheat would not grow, — the average yield is from forty to forty-eight bushels per acre; and I have already referred to a large farm where the crop on the whole farm, in 1844–5, — a most favorable season, — averaged fifty-six bushels per acre. These are most encouraging results; but since, beyond all question, in an instance referred to, eighty bushels have been produced, who will say that the limits of improvement have been generally even approached? All this too has been, without doubt, the effect of improved cultivation.

I have gone so fully into this subject that my readers may deem a recapitulation unnecessary; but the subject is so important, and bears so strongly likewise upon other crops, that I must claim their indulgence for a few remarks.

The success of no crop whatever can be commanded; there are agencies and elements concerned in the production far beyond the power or skill of man to command or control. But that culture may do much, is equally certain; and the circumstances under which it succeeds are those in which we are mainly concerned. The soil on which the improvements on Lord Leicester's estate have been made, was originally a thin, gravelly, and light soil; but it has been deepened by ploughing, and thoroughly pulverized, and enriched by manure. The manure has been applied to the green crop, the turnips or swedes, in a most liberal manner, at the rate of fourteen loads to an acre, when ten are ordinarily considered an ample allowance; but in addition to this, the crops have been consumed on the land by sheep folded upon it, and these sheep, during the folding, have been themselves liberally supplied with linseed oil cake, than which, excepting the flaxseed itself, nothing contributes more to enrich the manure. In some cases, Mr. Coke was accustomed to use rape cake as a manure, and this was ground fine and sowed in the drills with his wheat. There is no doubt of its efficacy, but it is not safe to use it without some mixture. The Dutch farmers dissolve it in their tanks of urine, and then apply it with great advantage. It is sometimes used as a top dressing between the rows of the growing crop. I have not found its use extensive.

Guano was not known as a manure in the time of Mr. Coke, but is now applied, properly mixed, by many farmers, with great advantage. The manure, however, which comes from animals folded on the land and fed liberally with linseed oil cake, is, beyond question, one of the most safe, one of the most enriching, and one of the most permanent in its beneficial effects, which can be applied. I believe the soil for wheat cannot be too deep; though, as I have already stated, it may be too loose at the top, and, in such cases, requires shallow ploughing and treading, or pressing on very light soils, in order that the roots may be firmly fixed in the soil, and the dirt not liable to be blown away from them. In Lord Leicester's cultivation, the seed was always drilled, and the crop most carefully horse-hoed, in which operation the dirt was thrown towards the plants. In the third place, the land was thoroughly cleaned of weeds. A gentleman, who visited the estate during the life of the former proprietor, states that in travelling over, and observing most carefully, a field of wheat of seventy acres, he discovered but one single weed, and that of charlock, which one of the workmen pulled up with a good deal of indignation. I will add only that success is always uncertain unless the land be thoroughly drained. Standing water upon the soil, or in the soil, is always prejudicial, and often fatal, to the crop. With respect to other matters connected with this cultivation, I have treated them so fully that I may leave it to my intelligent readers to form their own conclusions.

I believe that the average crop of wheat here may be fully doubled. I shall quote, rather as a curiosity, the following statement, which has been furnished me. A cultivator, in the end of August, 1843, planted in his garden thirty-two grains of wheat, of the very best quality, at six inches apart, and at the depth of an inch and a half. In 1844, this seed produced thirty-two plants, having from ten to twenty-eight stems and ears each; the average number of ears was sixteen; the average weight of each plant was one and three quarters of an ounce. An acre of land would contain, at six inches' distance, 174,240 plants; the produce, 304,920 ozs., or 19,000 lbs., or about 320 bushels, per acre. When a farm can be subjected to a most careful garden cultivation, though the expectation of any approach, upon any extensive scale, to a crop even of one third of this amount, would be deemed pure lunacy, it is apparent that a large increase of product may be confidently looked for. One would not be surprised at a great extension of spade husbandry, since I have been over a field, on one farm, of one hundred and fifty acres, thoroughly trenched to the depth of eighteen inches by the spade, and where the growing crops presented a promising appearance. This was done in a place where, and at a time when, labor was most abundant; the undertaking was a substantial benefaction to the poor; and the cost was not more than it would have been by brute labor.

I might speak of the diseases and accidents to which this crop is liable; but this would be to compose a treatise rather than a notice, and my readers will not expect it. One experiment made in the destruction of slugs upon wheat, by the application of salt, is highly important. Where slugs have appeared on the wheat, a farmer in Norfolk has been in the habit of sowing one hundred weight of salt to the acre, which, without injury to the wheat, has proved effectual to their destruction. In one case, where the operation of sowing was in progress, on discovering slugs, he sowed as above, and in two days they wholly disappeared. An application of lime to slugs proved harmless.* I have known, in New England, the application of salt mixed with manure prove effectual for the destruction of wire-worms, in a cornfield. Calculations respecting the amount of injury often done to the wheat crops by the wire-worm, rate it at more than £60,000 per year. Indeed, it may be much more than that, and is scarcely a subject of calculation. Many insects affecting the grain crops are considered as wire-worms, which belong to a different tribe of insects; and there are insects which prey upon other insects, and thus check their destructive ravages. The reflections of Mr. Curtis, an enlightened naturalist, on this subject, are so striking, that I know I shall gratify my readers by their quotation.

"Let us now pause for a moment, and reflect upon the extraordinary fact, that our corn, the staff of life, is placed in the power of this pygmy race; and that, destined as man is to earn his bread by the sweat of his brow, yet famine, accompanied by its concomitants, disease and death, may overtake him, (notwithstanding his industry, and let his prospects be ever so promising,) through the united operations of the insect race. How wonderfully displayed, therefore, are the wisdom and goodness of the Creator in so nicely balancing the destroyer and his parasitic enemies, as to keep man, naturally prone to indolence, ever on the alert! and yet, when the countless hordes of noxious insects fall like an irresistible plague upon his crops, that Hand which is ever ready to befriend mankind arrests the scourge. Myriads of parasitic insects are let loose, multiplying as their prey increases; the threatening scourge passes over with less loss than could have been anticipated; and in the succeeding year, to the astonishment of the farmer, instead of the mischief being increased, not an insect enemy is to be seen."*

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* Almack's Report of the Agriculture of Norfolk.

2. OATS. — Oats are cultivated largely in Great Britain. In Scotland and Ireland, they are cultivated extensively for food for the population; and, when the meal is of the best quality, in some forms in which it is cooked, it is not only palatable, but extremely agreeable. Porridge is prepared merely by boiling it in water, with some salt thrown in, until it reaches a proper consistence, and in this form is ordinarily eaten with milk. Brose is prepared simply by scalding the meal with boiling water, and throwing in a little salt. This is likewise eaten with milk. Oatmeal cakes are made of oatmeal, and spread out to a thinness not exceeding a quarter of an inch, and baked to a crisp. In many cases, I found a bitterness in the flour, which I apprehended arose from the seeds of some weed having been ground up with it; but, with this exception, the porridge and the brose, *when eaten with a plenty of cream and sugar*, (a little, as I thought, to the consternation of some of my Scotch friends,) was a most agreeable dish. A coarse quality of meal, in such cases, is preferred to that which is fine. It will not do to say that it is not a nutritious substance. The allowance, formerly, of a Scotch laborer was a peck of oatmeal per week, and two Scotch pints, or four quarts, of milk per day; and this comprehended the whole of his subsistence. Where more hardy or more skilful laborers are to be found; where we are to look for a finer race of people than the Scotch, — more erect, more muscular, more energetic, with more of physical or of intellectual power, — I know

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* Curtis on Insects affecting Corn Crops.

not; and this dish is, perhaps, never absent from a Scotch table, and, with a large portion of the Scotch, constitutes their principal diet. In England and Scotland, oats and beans form the chief food of their horses, with a comparatively very small portion of hay; and so many are kept for labor, sport, or pleasure, that the demand is immense. A pound of good oats is understood to give as much nourishment to a horse as two pounds of hay.

Oats are not cultivated very differently from the methods prevailing with us. They are most commonly sown broadcast, but sometimes are drilled, where the land is foul with weeds, and sometimes dibbled. When drilled, four bushels of seed are sown to an acre; when broadcast, it is not uncommon to sow six bushels; for though oats, like wheat, throw out side shoots, or, as it is termed here, *tiller*, yet the heads from the side shoots are seldom of much value. The crop varies from thirty to sixty, and sometimes eighty, bushels. It is strongly advised to cut oats early, as soon as the stalk turns yellow under the head, and even while the other parts of it are green. None are lost, in such case, by shaking out; the grain itself is brighter, and the straw is saved in a much more palatable condition for the animals to whom it is fed.

When grass land is broken up, oats are almost always the first crop taken. In this case, the land is ploughed and the sward completely inverted in the autumn, and then harrowed or lightly ploughed in the spring. In this way, the oats have the benefit of the decaying vegetable matter turned under. The oats, when sown broadcast, are most often harrowed in; but when ploughed, it is done with a light furrow, as they will not germinate when deeply covered. Oats are sometimes sown after turnips which have been fed to sheep folded on the ground. In this case, the ploughing is very light. Those, however, which are grown upon old grass or pasture land broken up, give generally much the largest return. Oats are grown upon soils of almost every description, but certainly not with equal success; and a strong, rich loam may be expected to give the best crop. The poorer the soil, in general, the more seed is advised.

In the admirable Agricultural Museum of the Highland Agricultural Society there are specimens of forty different kinds of oats; but it would be useless to give a mere list of names. What is called the common oat is the oat which, without any particular selection, happens to be cultivated in some particular district.

The potato oat, which I have often met with, is much esteemed The grain is short and white, the panicles well filled, and it is usually without beard or awns. But it is said to become bearded, from being cultivated too long on dry soils without changing the seed. The specimen in the Museum weighed forty-six and a half pounds per bushel. I have known this oat cultivated in the United States; the first year with success; but the second year the crop was much less in the number of bushels, and in the weight of the grain. I cannot think there are any insuperable obstacles to its successful cultivation in the Northern United States, unless they should be found in the intense heat of our summers. This sort is said to have had an accidental origin among a field of potatoes, and from that circumstance obtained its name.

The Hopetoun oat is another celebrated Scotch oat, which had its origin in an accidental selection. It is stated to be not so liable to be shaken out by the winds as the potato oat, and to be a few days earlier; its straw longer and stiffer, and not so likely to become lodged. It is esteemed better adapted for light than for strong clay soils; but is more liable to smut than the potato oat. For low meadows and newly-reclaimed lands, it is much esteemed. The sample in the Museum, which was selected from that exposed in the Edinburgh market, weighed forty-six pounds per bushel.

The black Tartarian oat is much cultivated in England, the white to a considerable extent in Scotland. The straw sometimes reaches six feet in height. These kinds are late, and require a very rich soil. They are well known among us, having all the panicles on one side; not often found unmixed, but, within my knowledge, successfully cultivated by an eminent farmer, in New Hampshire, on Connecticut River, whose crops average from sixty to seventy bushels per acre.

I have seen here a very superior oat from Archangel, in Russia, and greatly esteemed by Mr. Dickinson, at whose extensive and beautiful stables, in London, I met with it. He informed me it was cured by fire in the plant, and weighed thirty-eight pounds per bushel. He valued it for feeding, weight for weight, more than any other. It was a small oat, but long in proportion.

3. **Barley.** — This crop is very largely cultivated in England. It often follows turnips; and then, clover being sown with it, a good preparation is made for wheat. The uses to which it is applied in England are principally for malting and making into beer, of which the consumption is great beyond all ordinary calculation, malt liquor being the favorite drink of all the lower classes, and seldom absent from the tables of the rich and luxurious. In Scotland, much barley is used for distillation into spirits. Barley was formerly, and is now, in some countries, used for bread; but in this respect it yields to the finer grain, wheat, and even to rye and oats. It is used to some extent for feeding cattle and swine, but mainly for the purpose of malting.

Barley is of various kinds. One kind has two rows, and another has six rows, to a head. That which has two rows only is generally preferred. There are two kinds, distinguished from the time of sowing, as winter and spring barley, the former being sown in autumn. The alternations, in winter, of freezing and thawing, are prejudicial to winter crops, and an early sowing of the spring crop is strongly recommended. There is a coarse kind of barley, known as *bere*, or *bigg*, which is advised to be sown where the crop is to be cut for green feed. There is a kind, called the *naked* barley, which somewhat in appearance resembles wheat, and from which the corolla is spontaneously separated. This kind is said to be much esteemed on the Continent, but is not much cultivated in Great Britain. The bere, or bigg, ripens much earlier than other kinds, and is consequently adapted to a late climate.

Barley is sown broadcast or by drill, and harrowed in. It is advised that it should be sown always upon a newly-ploughed and fresh soil, and that it should be carefully rolled, either immediately upon being sown or after the plants are above ground. When barley is drilled, and it is intended to sow grass seeds among it, they may be sown after the barley is hoed, and then rolled; or, if the barley is sown broadcast, they may be sown with the barley. There is almost always danger, in such cases, however, of burying the grass seeds too deeply.

The cultivation of barley is so well understood in the United States that I need not enlarge upon it. One of the best farmers in England, whose premises I have had the pleasure of inspecting, drills in about three bushels and a half per acre, at seven inches apart, and then harrows it with a light harrow, and sows clover and other grass seeds upon it with a machine drawn by a horse, that it may be the more evenly spread. The barley under his management is always carefully weeded. A double-rowed barley, called *Chevalier*, from the name of the person who first selected a single head in his field and grew ultimately a crop from its product, has for many years been greatly preferred in England, and continues to maintain its high reputation. The average weight of barley is from forty-five to fifty-five pounds per bushel, and a crop on land well prepared is from thirty to fifty bushels. Its proportion of nutritive matter is sixty-five per cent.; that of wheat being seventy-eight per cent. On good loamy soils, barley is more profitable than oats. It is not so eligible on stiff and cold clays. It is considered not so great an exhauster of the soil as oats. A good deal is sown in the neighborhood of London, to be cut as green feed for milch cows in the large milk establishments. Machines are in use for *hummelling* barley, — that is, breaking off all the awns close to the grain, — and likewise for hulling it, so as to form what is called *pot* or *pearl* barley, a very nutritious and agreeable ingredient in broths and in drinks for invalids.

4. RYE is very little cultivated in Great Britain, and I have never seen it used here for bread. It is, however, sown for green fodder, and with great advantage, as it comes early. I have described already an early and extraordinarily-useful kind under the designation of *St. John's day* rye, which produced, besides being repeatedly cropped, thirty-six bushels to the acre. I believe that rye might be more extensively cultivated in England, to great advantage, for human food, if its proper use was understood, — for the feed of dairy cows in the spring, as nothing will produce greater secretions of milk than rye meal, — and also for the fattening of swine. In the best dairy districts of the United States, where the amount of cheese made to a cow is nowhere exceeded, nor within my knowledge equalled, — a draught of about three quarts of rye meal per day given to a milch cow, in the spring, before the grass is abundant, is amply compensated by the increased amount of milk and cheese produced; and I have known it applied to the feeding of swine with great success.

Having thus far treated the cereal or bread grains, called *white* crops, I come next to consider another class of plants, much cultivated and of great value in English husbandry.

5. BEANS. — Beans are of several kinds. The first division is into garden and field beans. Of garden beans very few are cultivated. String beans, otherwise called *French* beans, are common enough; but I have not met with our finest kinds of shell beans, such as the cranberry, the pole, kidney or caseknife bean, and, above all, that rich and delicious vegetable, the Lima bean. If they are known in England, it has not been my fortune to meet with them, either in the markets or at private tables.

Beans may be considered, in England, as a most important field crop, and are principally used for the feeding of horses, to which they are given, usually, broken and mixed with oats, — a quart of beans being considered as quite equal to two quarts of oats, — or with cut hay and chaff. They are likewise used in fatting swine; but they are considered to give too much hardness to the pork, excepting when it is to be used for bacon. They are deemed valuable likewise for fatting oxen, and increase much the milk of cows. They may be said to take the place with the English which Indian corn takes with us. Some quantity of beans are mixed with new wheat to be ground, as the millers say "that soft wheat will not grind well without them; and, as one shrewdly observes, they take care that in this matter there shall be no deficiency." I have eaten, in Scotland, bread made with a large proportion of bean flour, but I cannot say with much relish. The nutritive qualities of beans, as compared with wheat, are as sixty-eight to seventy-eight per cent. The ordinary weight of a bushel of beans is sixty-six pounds.

There are several kinds cultivated, which are known by different names; but the kind most approved is a small, round bean, of a dark color, and of nearly twice the size of a marrowfat pea. A well-cultivated field of beans is, in its early stages, a beautiful object. The land most suited to beans is a strong, rich loam, and a clay soil is congenial to them. Nearly seventy bushels have been obtained from an acre; sixty is a large crop; ordinarily, however, they do not exceed thirty bushels. Here they are sown early, — in February or early in March, — and ripen late. They are sometimes sown broadcast, and large crops have been obtained in this way; but it is not recommended, from the difficulty of keeping the crop clean, which is of the highest importance, where a wheat crop is to follow. They are usually drilled ten or twelve inches asunder, and the intervals hoed; and sometimes two feet, or two feet and a half, apart, and then carefully cultivated between the rows. The land, in such case, is commonly highly manured, the manure being rotted barn manure, spread and ploughed in; and, being kept as clean from weeds as possible, there is a fine preparation for wheat. In this way, wheat and beans are made to alternate on the same land for years, with advantage; though the land should be strong, to bear so severe usage, and the bean crop must be liberally manured. The rotation often adopted is, turnips, barley, clover, beans, wheat; where the land is very rich, it is, turnips, barley, clover, oats, beans, wheat, beans. The quantity of seed sown by drill for beans is two and a half and three bushels. Peas are sometimes sown with beans for a green crop, for the purpose of soiling; in which case, three bushels of beans and two of peas are sown; and this produces a nutritious and well-relished food for cattle and for pigs. Of crops which ripen their seeds few are less exhausting to the soil than beans. Beans, at harvest, are shocked in the field until dry, and then placed in stack to be, after a while, threshed out, either by flail or by a machine. The fodder, cut up with other fodder, in the spring of the year, is eaten by stock. Caution is advised in giving horses new beans, as they are very likely to founder them. The crop of beans here is certainly most valuable, in a climate where Indian corn will not grow; but it seems, in all respects, much inferior to that inestimable and useful product, the value of which, in my estimation, and the more I see of foreign husbandry, is continually rising. The small, white, kidney or round bean, so common with us, and so much eaten in some parts of the country, is not, within my observation, grown or used here.

I tried the cultivation of English horse-beans more than once in the United States; but they were always, in the time of flowering, destroyed by a small, black fly, which they seemed to attract in an extraordinary degree, and which stripped the stems completely of their foliage.

6. **Peas** do not appear to be extensively cultivated in England, as a field crop. The yield, when successful, varies from twenty

to forty bushels; but there is nothing peculiar in the cultivation. It is considered a valuable food for horses and for swine, and large quantities, raised or imported, in the form of split peas, are consumed in soups, &c. The garden culture of peas, in the neighborhood of London, and other large cities, to be sold green, is most extensive; but there is nothing remarkable in the process. With a view of forwarding them, the land is thrown into ridges, running north and south, and the seed is dropped on the south side, at the bottom of the ridge. High manuring increases very much the growth of the stalk, but postpones proportionately the forwarding of the pods. For five different and valuable kinds of peas, "the country," Mr. Lawson says, "is indebted to T. A. Knight, Esq., the late distinguished president of the London Horticultural Society, who obtained them by crossing or hybridizing some of the most esteemed varieties. From their remarkably-wrinkled appearance, together with the peculiar sweetness which they all possess, Knight's marrows may be said to form a distinct and most valuable class of garden peas." These are, certainly, most honorable contributions of eminent skill and science to the public good. The haulm of peas, as well as that of beans, is carefully saved, and much valued as fodder for cattle, and especially for sheep.

7. Vetches or Tares. — This plant is extensively cultivated in England, and considerably in Scotland; and, in my opinion, its cultivation may be strongly recommended in the United States. It is not much cultivated for the seed, as the permitting it to ripen would tend to exhaust the land; but the seed is usually imported from the Continent. The principal object of its culture is to furnish green food for stock, horses and milch cows, which are soiled. Tares supply an immense burden of most nutritious food. They are cut only once; but they are sown at different times, and sometimes as late as August, that the supply of green feed may be uninterrupted.

Tares are of two kinds, — winter and spring, — which differ in no respect, excepting in the habit of ripening; and the tares sown under favorable circumstances in the spring will not lag far behind those which are sown in the autumn.

The land should be brought into a state of fine tilth, and should be well manured. Sometimes they are sown upon a grain stubble, which must be carefully ploughed in and reduced. Three bushels is the quantity of seed to be sown to an acre where they are to be consumed green; two and a half where they are grown for the seed. They may be sown broadcast, or drilled, or dibbled; and the latter modes are recommended where the lands are foul with weeds. With winter tares it is recommended to sow rye; with spring tares, which are to be cut for feed, oats or barley may be sown, to improve the value of the crop. The crop is cut daily and fed to sheep, which are folded upon the ground, or cut and carried into the stables for horses and cows. Vast quantities are cultivated, in the neighborhood of London and other large cities, for the milk establishments, and for a change of diet for the horses which are kept there. The cutting of the tares may be begun as soon as they come into flower, and continued until the pods are fully formed; and if there is then a surplus, they may be cut and made into hay, so as to avoid the exhaustion of the soil by the ripening of the seed.

I am not able to give the amount of product which may be obtained from an acre, but from observation I know it must be very large. I do not know whether a larger yield can be obtained from it than from the improved Italian rye grass, of which I have given an account; but, as an article for soiling, it is easily cultivated, and would prove invaluable. The winter tares would scarcely endure our northern climate. The value of some portion of green feed to our horses kept in stables, in cities, would be very great; and a mixture of this with the dry feed upon which many of them are now exclusively kept from one year's end to another, would be greatly conducive to their health and comfort. Many a poor mechanic or laborer among us, with a small piece of land attached to his domicile, would find it quite easy to keep a cow, and obtain an ample supply of milk for his family, by the cultivation of some such crop as this. This plant is an annual. There are vetches which are biennial, but they are not recommended for cultivation. The seeds of tares are deemed vaulable for poultry. They will increase the flesh of horses, but are considered hurtful to them.

8. Turnips. — The next great crop in English husbandry is turnips. Of these there are several botanical varieties; but I avoid those distinctions, as of little value to general readers. There

are two great and well-known classes; the common turnip, of which there are three varieties, — the flat, the globe, and the tankard turnip; and the Swedish turnip, or ruta baga. The common turnip requires a shorter season, more quickly decays, and is a less substantial food, than the Swede turnip. The common turnip is usually white; but there are yellow varieties, which are nearly as solid, and almost as enduring, as the Swedes. Such, for example, is the yellow Aberdeen turnip, which will keep late into the spring, when the common white turnip has become corky and vapid.

The turnip has been cultivated for centuries in England; but it is within a comparatively recent date that it became a matter of general field cultivation upon light lands, and may be said to have effected a revolution in husbandry. The great value of it is in feeding stock, especially in the return which it makes to the land when it is fed to sheep folded upon the land; in the manure, likewise, which it produces when fed to cattle or sheep in stalls or yards; in the increased number of stock which its production puts it in the power of farmers to keep; and in its intermixture with dry feed, enabling them to make use of that dry feed to advantage, to which, otherwise, cattle could not be confined but at the expense of health and comfort. Though other articles may be useful and expedient — such as grain, and oil cake, and hay, — yet many sheep and cattle are now actually fatted upon turnips and straw. It is said that this is done with more difficulty at the south of England than at the north; the turnips in Northumberland, and at the north, being accounted richer, or more nutritious, than in the southern counties; thus seeming to confirm a strong opinion entertained by some persons that the colder the climate, the more nourishing the esculents grown in it. Another great advantage arising from the cultivation of turnips is in the cleanness of cultivation to which it leads, and which thus forms a suitable preparation for wheat, or the grain crop which usually follows them.

The land for turnips, if not stiff and hard bound, cannot be too rich for them; though the application of an excessive quantity of manure would be prejudicial, in some cases, to the succeeding crop of wheat, causing too rank a growth, and occasioning it to lodge. The common preparation for turnips is by a thorough ploughing in the autumn: then the land is amply manured, by manure spread on the furrow and lightly ploughed in. The manure, however coarse, in such case, will become fully decomposed by the spring. In the spring, this land is laid into ridges about twenty-seven inches apart, and the seed sown on the top of the ridge by a machine. In other cases, where the cultivation is more complete, furrows are opened in the spring, and the manure placed in the furrows; back furrows are then turned so as to form a ridge, upon which the turnips are sown by a drill machine, which, as it deposits the seed, deposits, at the same time, a quantity of ground, or dissolved bones, or some other artificial manure. Sometimes the bones are sown broadcast; and from twenty to twenty-five bushels of ground or broken bones are considered an ample dressing. On the application of bones as a manure, and their solution by sulphuric acid, — that great contribution of chemistry to agricultural improvement, — I shall speak under another head. About two pounds of turnip seed are sown to an acre. The practice of sowing broadcast, which formerly prevailed, is nearly abandoned; but it is still a vexed question whether they should be drilled in upon a flat surface, or upon ridges. Where the land is thin and liable to suffer by drought, the flat surface is to be preferred; but otherwise, in my opinion, ridges, with the manure placed under the plant, are much better. The ridges, for Swedes especially, should be at least twenty-seven inches apart, — for the common turnip a less distance; and the land may then be thoroughly cultivated between them. After the last hoeing, if the condition of the land admits of it, cabbages may be planted between the rows. The interval at which the plants are left on the ridge is, generally, about a foot. Mr. John Bloomfield, of Holkham, one of the favorite tenants of Lord Leicester, and from whose experience and excellent farming I derived much valuable instruction, states that he gets a better crop when his Swedes are left at eighteen inches apart. Six inches apart is enough for other turnips.

Turnips, in the first part of their season, cannot be cultivated too much. The fly is the great evil, in the turnip crop, with which the farmers have to contend. A preventive is found by some farmers in late sowing. The flies are accustomed to appear at a season when, ordinarily, the plants are in readiness for them. By postponing the sowing ten or twelve days, the flies will have passed their period, and the crop is safe.

The turnip crop is to be considered, as I have already remarked, as the foundation of the improved husbandry of England, in the means which it affords of supporting an increased stock, in the abundance of enriching manure which it thus supplies, and in the cleanness of cultivation to which it leads as a preparation for other crops. They are usually fed off in the field; the white turnips, often, as they are grown, in the ground, — which I cannot help thinking a slovenly mode of husbandry. But in most cases, they are pulled and topped, and tailed, and cut by a machine, and fed to the sheep in troughs on the field where they grew; the fold, which is composed of movable fences, being changed from one part of the field to the other, until the whole is gone over, and the crop consumed. They are sometimes spread upon grass lands, both for cattle and sheep, but are most commonly given to cattle in stalls. Many of the best farmers pull all their turnips, and feed them to their cattle and sheep in their straw yards; which enables them to convert their straw into enriching manure. The Scotch farmers in the Lothians, and the farmers in Northumberland and the northern counties, who grow immense quantities of turnips, sell them to feeders of sheep and stock, as they stand in the field, upon the condition that they are to be consumed where they grow. The sheep and cattle are brought, in such cases, from the Highlands in the north, and are here prepared for market. The climate of England enables the farmers to leave their turnips, for the most part, in safety, in the ground, during the winter, and to gather them as there may be occasion. The Swedes, if not pulled, and if left to thaw in the ground, suffer little from frost. Various modes are adopted for protecting them, in parts of the country where it is deemed necessary or expedient; and they must, of course, be removed, where a grain crop is to be sown in the autumn or early winter. I need not describe these modes, as few of them would be applicable to my own country. Swede turnips may, as I know by repeated experience, be kept well during our coldest winters, by being laid upon the ground, where the bottom is dry, and piled up in a long ridge, like the pitched roof of a house, being first covered lightly with straw, and then with dirt, — holes being left in different places, as ventilators for the heat to escape; and then, as the cold increases, the covering of straw and dirt is to be increased. Access may be had to them, in such case, at the southern end, which may be kept fortified against frost by loose bundles of straw packed. In this way, with care, they may be well preserved until spring, and be at hand through the winter for the stock. They may be well kept likewise in bins, in our barns, well packed round, top, bottom, and sides, with coarse hay. This is an excellent and most convenient mode. In our cold climate, the covering must be liberally and carefully returned, if they are opened occasionally for a supply.

I believe our farmers would find a very great advantage in growing esculent vegetables for sheep and cattle, instead of keeping them, as is now done, through our long and severe winters, exclusively upon dry feed. They would be most useful for sheep in the lambing season, and for cows in milk; and though, in fattening properties, I know no article, all things considered, superior to our Indian corn, yet they certainly would come most beneficially in aid of that. I do not assert that turnips are the best crop, for this purpose, which can be grown, but Swedish turnips are certainly among the best. Mangel-wurzel, carrots, cabbages, parsnips, and potatoes, are all useful. I may recur to this subject again; but the conclusion to which I have myself come, and in which I am daily confirmed, and with which I wish the farmers of the United States could be more and more impressed, is, that an abundant supply of succulent food should be provided for their stock during our long winters, — first, as conducive to the health of the stock; and next, as contributing essentially to the improvement of fattening stock, and as enabling the farmer to keep more stock; and lastly, as furnishing him with the best means of enriching his farm, and extending and improving all his other crops. These have been the striking and universally-acknowledged results of such a system of husbandry here; and I have not a doubt that, in those parts of the United States from which the markets in our cities are to be supplied with beef and mutton, though, from the severity of our climate, it might with us be a more laborious process than here, and we could not have the advantage of feeding off our green crops on the lands where they grew, yet its great benefits would be an ample compensation for any extra expense or labor to which it might, in many situations, subject us. The difficulty and expense of procuring labor may present itself as an objection; but that will be constantly diminishing. Improved machinery, and new implements of husbandry, are yearly affording increased facilities in cultivation; and, for our husbandry to be successful, it will require the liberal application of capital, added to enterprise, experiment, effort, and perseverance.

The following result of an experiment, by Mr. J. Bloomfield, of Warham, Norfolk county, to determine the best distance at which plants should stand, was given me by this excellent farmer, and will be curious to my readers. It was made upon Swede turnips. The row was twenty yards long.

Rows.	No. of Turnips in each Row.	Distance apart in the Row.	Average Weight of each Turnip in the Row.	Weight of all in the Row.		Produce per Acre, topped and tailed.	
		Inches.	*lbs.*	*Stone.*	*lbs.*	*Tons.*	*Cwt.*
1	32	24	5¼	11	12	24	4
2	38	22	3¾	10	2	20	1
3	39	20	3½	10	00	19	13
4	40	18	3	8	10	17	15

Fractions are omitted. The stone is 14 pounds.

9. Potatoes, Beets, Carrots, Parsnips. — Of these several crops I see nothing peculiar in the cultivation in Great Britain, which would require me to treat them at any great length.

The potatoes brought upon the table are, in general, of a much better quality, drier, and more mealy, than those grown in the United States. The potatoes grown on new land, however, in the Northern States, are excellent; and the potatoes brought to market from the northern parts of Maine, and from Nova Scotia, are not excelled by any which I have met with. Within my own observation and experience, likewise, I have found that the finest seed potatoes from this country, planted in the United States, with the exceptions above referred to, have, after the first year, deteriorated, and become conformed to those usually planted in the country. It is demonstrated, therefore, to my mind, that new lands yield potatoes of a better quality than lands which have been long under cultivation; and that a low temperature and damp climate, such as are found in the northern parts of Maine, and the British Atlantic provinces of North America, are favorable to potatoes, while in hot and dry climates the quality of the vegetable is inferior.

Potatoes are almost invariably planted here in drills or furrows about thirty inches apart. The furrow is first opened; the manure laid in it; the potato planted; and the land reversed by the plough, so as to cover the seed. They are then, just after appearing above ground, often harrowed; and, after getting to some height, the harrow, or cultivator, is passed between the rows; and they are earthed up with a double mould-board plough, or by a single plough passing twice in the furrow. When ready to be dug, or, as it is here termed, *lifted*, a double mould-board plough is passed down once, or a single plough twice, through the row of potatoes; those are picked up which are thrown out; and then the whole field is thoroughly harrowed, which brings the remaining potatoes to the surface to be gathered.

Two or three points seem to be well established here; first, that, in planting, it is better to use whole than cut sets; that, where they are cut, the seed end of the potato is more productive than the opposite end, and, while the former is used for planting, the latter may be saved for food; and lastly, that the crop is considerably increased by early plucking off the blossoms. I have already described the lazy-bed mode of cultivation, and the large crops sometimes obtained, in my account of the Agricultural School at Glasnevin. In general, however, the crops are not large, not much exceeding two hundred and fifty bushels to the acre, which, though a respectable, is certainly not a great yield. Potatoes are raised largely for the market in some places; but, in passing through the country, the extent of land under cultivation in potatoes appears comparatively small.

I cannot join with Cobbett in his anathemas upon potatoes, to which a learned agricultural professor here has lately added the force of his denunciations, which are likely to fall harmless under the power of habit and general taste. There certainly can be found, as common consent seems to have established, no more agreeable, and no more nutritious esculent than a well-cooked potato; and under few crops will an acre of ground yield more food for animals. The disease which has prevailed in the potato — the ravages of which have been so extensive and alarming — will, it is hoped, prove only a temporary evil, or some effectual remedy against it be found. In Ireland, a large number of the population, amounting to millions, depend, almost exclusively, upon the potato for subsistence. The ordinary allowance to a working Irishman is, from fourteen to sixteen pounds of potatoes per day. It cannot be denied, however, in a moral view, that potatoes to the Irish are an equivocal good. In order to improvement, man requires a constant and severe stimulus to exertion. The necessities of men are the excitements to industry and enterprise, and very often the foundation of their virtues. But what hope can be entertained for the improvement of persons content to live upon the meanest fare, and in circumstances of destitution barely compatible with existence, and to go on and marry, and rear children, with no expectation or ambition beyond that of a mud cabin, a peat fire, and a potato diet?

Next to potatoes and turnips, beets occupy a principal place in English cultivation. Of beets, the field cultivation is limited to the mangel-wurzel. These are cultivated in rows, upon ridges, similar to the cultivation of turnips, about thirty inches apart; and though the seed is commonly dibbled in at six inches distance in the rows, the plants are thinned out to a distance of one foot. Deep cultivation is always strongly recommended for all tap-rooted plants. An eminent farmer in Northamptonshire, after having furrowed and manured the furrows for his mangel-wurzel, as the wheels of the cart and the trampling of the horses tend to harden the bottom of the furrow, before the land is turned back upon it in order to form a ridge, passes down in the furrow with a miner, that he may loosen and deepen it. A *miner* is simply the colter of a plough, without the mould-board. He speaks of this as being attended with great advantage. No machine has yet been invented which may be safely trusted to drop the seed. A wheel with pegs of about two inches in length, and six inches apart, upon the outside of the wheel, which shall make holes in the ground as the wheel revolves, handles like those of a wheel-barrow being attached to it, is used to dibble the land, into which children, who follow, drop the seed, one being sufficient in each hole, as every capsule in fact contains four seeds. The seeds are then covered with the head of a rake or with the hand. The land between the rows should be kept loose by ploughing, and thrown upon the rows, but not upon the plants, whose nature it is to grow much out of ground. In the latter part of the season, the under leaves may be gathered and fed to milch cows, or sheep, or swine, with great advantage to the consumer, and, where the crown is left unbroken and only the lower leaves taken, without injury to the producer.

Reports have been furnished me of crops of fifty-eight tons per acre, and, in other cases, of forty-eight tons, and fifty-six tons, per acre; this, of course, after they were topped and cleaned. These, however, are very extraordinary crops, the common yield being about thirty tons. They are much valued for milch cows, and for fatting cattle. Experiments have been made to test the value of mangel-wurzel compared with Swede turnips in the fattening of cattle. The experiments which have come under my knowledge — the estimate of the increase of weight of the animals experimented upon having been made from external measurement, and not in scales — do not appear to me decisive, but only indicative of considerable superiority in fattening properties of the mangel-wurzel over the Swedes. The yield of mangel-wurzel, per acre, under good cultivation, is considerably greater. Caution is to be used in giving them to milch cows, as they are apt to produce scouring. From this effect I have suffered in the free use of them with my own cows. It is strongly advised, likewise, not to use them until the spring or late in the winter; and I have known farmers to keep them sound and fresh into August. They are considered as not unfavorable to wheat, which may be sowed after them. The seed of the beet should be well soaked before sowing; and it is advised, in the event of transplanting them to fill up vacancies, not to place the plant lower in the ground than it formerly stood, as otherwise, if planted to the top, it will send out shoots from the top, and become scraggy or forked.

Carrots are cultivated to some extent, and much valued. There is nothing, however, peculiar in the cultivation. The land should be deeply ploughed and highly manured. They are usually cultivated on a flat surface; but I am satisfied that the ridge cultivation at a distance of two feet, so as to plough between them, would be far preferable. The seed should be sprouted before sowing and mixed with sand, in order to avoid its being sown too thickly. If sowed on ridges, they will be much more easily cultivated and kept clean; and they should be thinned out to the distance of six inches apart. The Belgian white carrot has come greatly into favor in England. A distinguished farmer, in whose authority I place the utmost confidence, pronounces it as thirty per cent. more productive than the common carrots; and I met with an eminent farmer who had grown thirty-one tons seventeen hundred weight upon an acre, and whose crops averaged twenty-four tons per acre. Another farmer informed me, that he usually obtained twenty-five tons per acre. A farmer, at Birkenhead, near Liverpool, who is laying the foundation of one of the most splendid agricultural establishments in England, and whom I had the pleasure of visiting, obtained a crop of a hundred tons from three acres. Much of this was due to the liberal application of guano. Another farmer reports having grown upon four acres four thousand eight hundred bushels of the white carrot, or twelve hundred bushels per acre, which he fed to his horses, ten pounds each per day, and to his neat cattle, with very great advantage. A strong prejudice exists against the use of white carrots for horses, as injuring their eyes; and the farmer first mentioned above thinks it not without foundation, believing that his own horses had suffered from that cause.

With respect to the common red beet, or the sugar beet, and the parsnip, I have not seen them under field cultivation in England, though the parsnip is said to be largely cultivated, as feed for stock, in the channel islands. The sugar beet is reported to yield abundantly, and to furnish a more nutritious food, better for fattening, and for milch cows, than the mangel-wurzel; yet the former has not supplanted the latter. The Jerusalem artichoke is often served at table, and is approved by many as food for stock, but is not so palatable or so nutritious as the potato. It grows, however, without much care, and in almost any ground, besides continuing itself in the ground from year to year. Under favorable circumstances, it is said to yield five hundred bushels to an acre, — a statement which I do not give from personal observation, nor receive without some distrust.

10. CABBAGES. — Cabbages have been cultivated to a considerable extent in England. There are many varieties; but my province lies only with those which are cultivated for the feed of stock; and this embraces two principal kinds, — those with spreading leaves, from which the leaves are plucked, and then

others produced, and those which form compact and solid heads, such as the drum-head, and the savoy, weighing, in some cases, upwards of forty pounds each, though such must be considered as remarkable. In Scotland, they are rarely cultivated as a field crop. In the south and most temperate parts of England, they may be safely left in the ground, uncovered, through the winter.

The usual course is to plant them in a nursery, and then remove them to a field; and the largest kinds require ample room, and may be planted at three or four feet distance each way. In transplanting, a dibble is commonly used; but, in such case, the root is often doubled up and crowded into the hole, to the injury of the plant. A better way is, to plough a furrow, and, taking the plants singly, cut off a portion of the top, and dipping the root ends in some liquid, lay them at proper distances in the furrow, and then cover them with a plough; having a third person to follow, who may relieve any plants which may have been too deeply covered, and pressing the earth against the roots of those plants which require it.

Cabbages are deemed most excellent food for sheep and stock, though some persons consider them as of too laxative a nature for cattle — a fault which would be corrected by an ample supply of meal, or some dry feed, given in conjunction with the cabbage. Oil cake is given with them to fattening sheep, with extraordinary advantage.

Cabbages are considered as great exhausters of the soil; but where they are consumed upon the farm, they undoubtedly make a full compensation for what they have abstracted. At Ockham Park, in Surrey, the seat of the Earl of Lovelace, which I had the pleasure of visiting, they have been cultivated, for several years, in connection with a crop of beans. The beans are planted in double lines, four inches apart, and with an interval of three feet to the next row. The ground between the rows of beans is then carefully cultivated, until the time of setting out the cabbages, which are then planted, two feet apart, in the rows. The beans are harvested in August, and the cabbages are then ploughed and cultivated, and are ready to be fed off in December. He thinks that he gets as much feed from the land by this crop as he should obtain from a crop of common turnips, though not as much as he would obtain from a crop of swedes; and the crop of beans is not diminished. Indeed, he adds that the crop has increased since he began the practice, having been at the outset, for five years before the combination of the crops, about thirty-five bushels to the acre, and, for five years after uniting the crops, at the rate of forty-one bushels per acre.

Our winters in the North United States would present insuperable obstacles to the preservation of cabbages, to any great extent, as winter food for stock; but the same objections would not hold at the south and in the Middle States. The cultivation, however, cannot be said to extend itself in England, the Swedish turnip being generally preferred.

Some years since, an English farmer, by the name of George Adams, published what he terms "A New System of Agriculture and Feeding Stock," for which he obtained the king's letters patent. The pamphlet, though containing only about thirty pages octavo, was sold at a guinea a copy. I caused it to be republished, some years since, in the United States, — not from any confidence in his plan as being feasible, but as suggesting some hints as to the amount of produce possible to be obtained from an acre, which might induce inquiry and experiment, and, in that way, contribute to agricultural improvement. As the work now is scarcely known on either side of the water, I will transcribe a few passages, which I think will interest my readers.

"By pursuing," he says, "the following directions, a single acre of land will produce a crop sufficient to feed, in one year, twenty-four beasts, or two hundred and forty sheep."

"In September, or sooner, let your land be well manured and properly ploughed, so as to raise a good deal of fine mould; then plant one third of an acre of the land with the large sort of early cabbage plant, viz., the late York or sugar-loaf; one third more, in February or March, with the same sort of cabbage plant; and the remaining third of the acre, in February or March, with the ox or drum-headed cabbage plant. If the land be good, I would recommend that the plants should be set in rows three feet wide, and two feet between each plant, that is, three plants in every square yard. Upon this plan, an acre of ground will require fourteen thousand five hundred and twenty plants, reckoning five score to the hundred; but if the land be poor, it will be advisable to set the plants thicker proportionably, according to the grower's judgment of the quality of his land. By the beginning of June, the first crop of cabbages will be in perfection. Then put either six beasts or sixty sheep, in the manner here directed, according to the plan of the movable houses, herein annexed, either for cattle or sheep. Let the cabbages and leaves be carefully cut off, leaving the cabbage stalks cut across at the top, to grow again. The cabbages, upon good land, may be expected to average fifteen pounds apiece, which will be, upon the acre, two hundred and seventeen thousand eight hundred pounds, or one hundred and eight tons eighteen hundred weight, at five score to the hundred weight. Allow to each beast, or ten sheep, two hundred pounds every day and night, which will be twelve hundred pounds a day and night, for six beasts, or sixty sheep; in eighty-four days, or twelve weeks, these will be fat. Then put up six other beasts, or sixty more sheep, which will fatten in the same time and manner, viz., at the end of the half year. Eighty cabbages will have been consumed daily, amounting to fourteen thousand five hundred and twenty cabbages, just the number planted upon the acre, which, taken at fifteen pounds apiece, amounts to one hundred and eight tons eighteen hundred weight, at five score to the hundred weight; so that the feed of twelve beasts, or one hundred and twenty sheep, stands as under.

					Tons.	Cwt.
For	84 days, or	12 weeks,	6718 cabbages,	at 15 lbs. apiece,	50	8
"	84 "	" 12 "	6718 "	" " " "	50	8
"	13½ "	" 2 "	1084 "	" " " "	8	2
	181½ "	" 26 "	14520 "	" " " "	108	18

As soon as you begin to clear off a few rows of cabbages, after the 1st of June, spread the dung and urine carefully over the ground, leaving all the cabbage stalks, which will soon sprout again; then with a small hoe work the ground regularly over, so as to cover the manure, and sow turnip seed amongst your cabbage stalks, as you clear off the cabbages, and continue to do so till you have gone all over the ground the first time. About the 1st of November you will have another crop of *keep* as good as the first; and then, as you clear off all the cabbage sprouts and turnips, you must again properly apply your manure all over the land, as before, which is now either to be ploughed or dug, and planted as at first. Thus you will have a regular succession of good keep, and if the winter's produce be what may be expected from good management, the same acre of land will feed, in one year, twenty-four beasts, or two hundred and forty sheep. This, like all other crops, will, of course, vary with the season; but, if the weight here mentioned be produced, the number of cattle above stated will hardly get through it. In case of a failure, in the winter, a little hay or corn may be given to supply the deficiency."

Such is the author's account of his scheme, in his own words. It will be seen that he goes into a fraction of time, to meet the exact amount of keep which he proposes to obtain from the land. He proposes, as a part of his plan, to keep his beasts and sheep in movable houses or folds, so that they may be placed directly by the feed which is grown for them, and that the most careful provision should be made for the saving of all their manure.

I shall not discuss the practicableness of his plan. I have no confidence in it to the extent to which he proposes to carry it. But it shows the author's strong conviction of the advantages of soiling, and it leads to that great question, the full answer to which has not yet been approached, What are the productive powers of an acre of land? That cabbages in the Northern United States cannot be relied upon for winter feed, except in a very limited degree, is certain; but where the plants are forwarded by artificial heat in the spring, they may be made to furnish a large amount of autumn feed, and may, in many cases, be cultivated to great advantage. Any methods by which the farmers in the old states, near the great markets, can increase the means of enriching their lands by the growth of products to be advantageously consumed upon their farms, certainly deserve consideration. They may purchase manure in the cities; but even if the cost of the manure, at first, is small,—and in most cases it is otherwise,—yet the expense and trouble of transportation are always considerable and vexatious. Whether it shall be by the production of milk, by the fattening of swine, of sheep, or of cattle, must be determined by local and individual circumstances. The proximity to a quick market in such cases will always, in respect to many products, give the farmer in the old states, and near the large cities, peculiar advantages. I have some doubts, however, whether, for the purposes of soiling, for milk, or for fattening, any product can be found equal to that of Indian corn cut green. The cultivation of a variety of feed may be advisable, as in the event of the failure of one kind of crop another kind may succeed; and that animals thrive better upon a variety of food than when confined to a single sort is a point well established.

11. Rape. — This crop is seldom, within my observation, cultivated for seed, but as a green crop, for the purpose of feeding sheep, which are soiled or folded upon it. In some parts of the country it is sown in August, to be fed early in the ensuing spring; but it would not endure our winters. It is most generally sown in May, and at successive times, so as to provide a continuance of the feed, and comes into eating in about three months after being sown. It is sometimes sown broadcast, and left under a slovenly cultivation, to take its chance; but it is advisable to sow it in drills about twelve inches apart, and then the weeds may be extirpated, and it may be kept clean by the hoe. In such case about four pounds of seed are sown upon an acre. Sheep, being folded upon it, gain flesh rapidly; and the ground, in that case, is much enriched for a crop of wheat, or other grain, which may be sown after it is thus fed off. It must be completely fed off before it passes out of blossom. I was told, in Lincolnshire, that the ears of lambs which are thus fed upon it are often made so sore by some acrid matter which proceeds from it, as sometimes to lose their ears; but whether this was stated for the benefit of my credulity or not, I am not certain. I can only say that, if — which I am not willing to believe — it was told me with that view, the relater would himself deserve to have his own ears gently clipped. The ear is said to swell, ulcerate, and drop off. Another farmer, on whose opinion I place great reliance, speaks of this crop as too heating to the blood of young sheep, and advises, where they appear affected by it, to bleed them in the nose and give them salt. I always regard a preventive as much more valuable than a remedy; and confess, if such were likely to be the usual effects of feeding upon this plant, I should be very cautious in advising its cultivation. It is much grown, however, for the purpose of feed, in Yorkshire and Lincolnshire, and these objections were not frequently made to it.

When this plant is grown for seed, the yield is represented as about thirty bushels per acre; but it is then deemed a great exhauster of the soil, and will not bear a repetition under five or six years. Cole and rape, though often spoken of as the same thing, differ from each other — the cole growing stronger, and ripening its seed much later. When grown for seed, they are cultivated in the same manner, being sown in drills, and the plants thinned to five or six inches apart, and carefully weeded and hoed. The production of seed from cole is more than from rape. When fed upon the land by sheep folded upon them, they enrich the land; but in leases a clause is often inserted forbidding their cultivation for seed, because of their exhaustion of the soil.

In passing through Lincolnshire, I could not help admiring the sagacity of a dog whose business it was, in the character of a rural police-officer, to keep a flock of sheep upon a field of rape, and away from an adjoining field of turnips. I do not know that this sagacity would have been increased had he been without his posterior appendage, and stood upon two legs instead of four. The learned author of the "Vestiges of Creation" would probably have pronounced him far advanced in the transition state.

12. Mustard. — I found mustard cultivated in some parts of the country, but not to a large extent for the seed. It may be sown either broadcast or in drills, and is gathered by being shaken by hand into a sheet in the field. A good crop is estimated at twenty-eight bushels per acre. A strong prejudice exists against the black mustard, as the seeds remain a long time in the ground, and are with difficulty eradicated. In many leases the cultivation of it is forbidden.

The white mustard is not liable to the same objection; and this is often cultivated for the purpose of folding sheep upon it, and is said to yield a better crop than rape for this purpose. It has been sown in May, and eaten off in July; it has been sown after a crop of oats, and eaten off in October. In all these cases, when fed on the ground or ploughed in, it has proved a great enricher of the land. The amount of seed sown has varied from seven pounds to sixteen pounds per acre. It is recommended by some farmers for folding ewe sheep upon, in autumn, as indirectly assisting the increase of the flock. Neither of these crops requires very high manuring; and they are often grown, with tolerable success, upon land of moderate fertility, never contravening, however, the inviolable rule, that fire is not to be made without fuel, and that good land, good cultivation, and good manuring, are the only certain foundation for expecting good crops of any kind.

13. CHICCORY.—Chiccory is cultivated in some parts of the country. It was first introduced as feed for cattle and sheep, its leaves being abundant, and very succulent. It could, for such purpose, be cut once the first year, and four or five times a season, after it became established. It was not, however, found superior, as green feed, to other plants cultivated for this purpose, and it was thought to give an unpleasant taste to the milk and butter. It is now, however, cultivated almost exclusively for the roots, which are used for the adulteration of coffee, and many persons think with advantage. I am not of that number. The land on which it is to be cultivated must be rich and highly manured, as it is important, where the roots are to be used for this purpose, that they should be forced as much as possible the first season, as they become too old and hard in the second year. Chiccory is to be sown in April, like carrots, in drills, kept clear of weeds, and the plants thinned out to a distance of six inches in the rows. In September, the leaves are taken off, and the plants dug with a fork; they are then washed and split by hand, and kiln-dried, and sold to other factors, who cause them to be burnt and ground like coffee, which, in that case, they entirely resemble. They greatly deepen the color of the liquid, when prepared as coffee; and, when mixed in the proportion of a fifth, they communicate no unpleasant taste. Chiccory is deemed very exhausting to the soil, and liquid manure is applied to it, while growing, with great advantage.

The cultivation of woad was pursued to a considerable extent in the same neighborhood; but as this, together with madder, will come more fully under view in my observations on continental husbandry, I for the present pass them over.

14. LUCERN.—This plant is cultivated to some extent for the purpose of soiling, and indeed could not be expected to be cultivated as a field crop. It is undoubtedly a much superior forage to vetches or tares, and is more productive than clover, not yielding more weight at a single cutting, but growing much faster, and therefore may be cut more frequently. But it is far less cultivated than either vetches or clover, perhaps for the reasons that lucern, though it will bear it even the first year, does not come into a perfect state for cutting until the third year; that it

requires a good deal of labor at first in keeping down the weeds; and that it does not take its place in any rotation of crops, it being expected to occupy the ground for a length of years, where it is once planted.

All agree that it affords a most excellent feed for horses or milch cows; and it is advised that, after being cut, it should be kept over a day before it is given to cattle, as, in that case, it will undergo a degree of fermentation, which will prevent its being injurious to them. The yield of an acre of good lucern, it is said, will fully keep four horses from May to October. The time for cutting it is when it is in flower; and, though it is almost always given green, yet it makes excellent fodder when converted into hay. Some persons advise that the first cutting should be before the plant comes into flower, believing the succeeding crops will be more vigorous for this early cutting. It is commonly believed that a plant is more nutritious when in flower than at any previous stage of its growth; though this conclusion is not conformable to some of the deductions of Sinclair, in his experiments upon grasses at Woburn.

It requires a deep, rich, and dry soil, as it sends down its taproot far into the ground, and in time of drought draws moisture from a great depth, which keeps it in a green state when most grasses fade and are burnt up. The ground should be deeply ploughed, or, better, should be spaded or trenched, and thoroughly drained, as a clayey, wet, or retentive soil is unfavorable to it. Great pains must be taken to keep it clean from weeds.

It is cultivated in two ways — either by being sown broadcast, in which case, where it is kept thoroughly clean from weeds for two or three years, it will acquire such a hold as to dispossess the weeds, but will be benefited by being rather heavily harrowed in the spring; or it may be sown in drills about twenty inches apart; in that case, it may be cleaned by a horse hoe or scuffler, and be effectually protected from other plants or weeds. When sown broadcast, it is advised to sow about sixteen pounds of seed to an acre, and this may be sown with barley or rye; but when sown in drills, ten pounds of seed are deemed sufficient. The broadcast method is likely to give the best crops.

It is said that it will not endure severe frosts, and consequently is not suited to a cold climate; but I have known it cultivated successfully for many years by the late excellent "farmer's friend," John Lowell, Esq., near Boston. The great impediment generally found to its cultivation is the difficulty of keeping it from weeds; but the sowing it in drills will give an advantage in this matter. I have no means of comparing it, in point of value or product, with the Italian rye grass, of which I have given an account; but its reputation has long been established as one of the most valuable plants which can be cultivated for the purposes of soiling. It may be expected to last for eight years, and some persons assert a longer period, and will be benefited by occasional top dressings.

Lucern has been cultivated, with great success, by a farmer of the name of Rodwell, whose account I think will be read with interest.

"My growth of lucern this year, (1841,) in a field of eight acres of sandy soil, with a dry, sandy loam for its subsoil, being the third year's growth, (the seed having been sown, twenty pounds per acre, 1838, by a Bennet's seed-engine, with a crop of barley,) produced me, in its first mowing, (which commenced May 24th,) six weeks' entire support for thirty horses, keeping them in good condition and good health, while in constant employment. The second mowing, begun July 3d, fed me twenty horses for six weeks; and the third, begun September 15th, supported thirteen horses fourteen days; after which, the autumnal feeding with sheep was equivalent in value to the expenses of cleaning, &c., in the previous spring, which was effected by the extensive use of the Finlayson harrow — a process necessary every second or third year, if upon soils inclined to grass. The only manure used upon this crop has been soot, at about thirty bushels per acre, applied twice since the sowing in 1838." *

15. SAINFOIN. — This plant is cultivated in localities where a chalk or calcareous soil prevails, both for soiling and pasturage. It is sometimes, likewise, made into hay, and forms excellent fodder. It is universally understood that a calcareous or limestone soil is most congenial to its growth, and one must hesitate in distrusting the lessons of experience; but the best crop which I have seen of it — and an admirable crop it was — I found upon an

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* Journal of Royal Agricultural Society, vol. iii. p. 238.

extremely rich loam, which, from its high cultivation, might be called a vegetable garden mould, and to which no lime had been applied, and none certainly was apparent.

It is a highly-productive plant, with small, pointed leaves, rather coarse branches and stem, and bearing a small blue flower. It may be cut twice in a season, and then fed, and will yield, under good cultivation, from one and a half to two tons of dried fodder to an acre; but it is not so productive as lucern. It is not so apt to become heated as clover, not being as succulent; it will grow where clover will not grow; and drawing its nourishment from a greater depth, it is less liable to suffer from drought. It may be cut, and afterwards fed off by sheep the first year of its growth; but it is not in the best condition for mowing until about the third year after planting, and then it will continue for eight or ten years. I have said one of its principal uses is for soiling, and for this it is much esteemed. Though it may not be so valuable as lucern, clover, Italian rye grass, or Indian corn, where the latter can be grown, yet there is an obvious advantage in a variety of food; it is more agreeable to the animals themselves, and some plants will flourish in some seasons, and some soils, in which others would fail. I have seen it cultivated in New England in one case only, and that not with much success; the winter was deemed too severe for it.

The amount of seed sown to an acre is four bushels in the chaff; and it may be sown with barley, or alone. The seed is of very uncertain quality, and should be tried in a pot. Sainfoin is a great exhauster of the soil, when suffered to ripen its seed.

Lord Essex gives an account of curing a crop of sainfoin, which was cut on Monday and Tuesday of the last week in June, when in full flower. It was once turned on Wednesday, and carried and stacked on Thursday and Friday. The weather was dry and hot, but the hay was still so green, that much moisture exuded upon pressure. It was stacked with alternate layers of oat straw. It came out in the finest condition, and the interleaved straw was much improved. It is well known that, with us, clover is often cut in the morning, turned once merely, in a hot sun, and then packed away, the different layers being well salted, at the rate of more than a peck of salt to the load. In this way, where the moisture proceeds from the sap, and not from rain coming upon it, I have known it effectually preserved, and furnishing an excellent fodder.

There are different kinds of sainfoin, some of them distinguished from others by a greater earliness. I saw, in the same field, side by side, and where both kinds had been once mown at the same time, a second crop coming on, where, in one case, the plant was in full flower, and, in the adjoining land, the plants showed no signs of flowering. I know no means of distinguishing one from the other in such a case, but by actual trial. The farmers who cultivate this crop successfully esteem it very highly. The Messrs. Lawson, of Edinburgh, speak of having, in 1833, introduced from France the double yielding sainfoin, — a very luxuriant growing variety; but I have not seen it.

16. Crimson Clover, (*Trifolium Incarnatum.*) — This is an annual plant, presenting, in its blossoming, a beautiful crimson flower in the shape of a cone. It is a very productive plant, and is principally valuable as green feed; made into hay, it is deemed superior to the common clovers. Here it is sometimes sown upon a wheat or grain stubble, the stubble being simply harrowed, and the seed sown; and it is then bush-harrowed and rolled. This gives a good crop for green feed the ensuing spring. It is said to be a fortnight earlier than lucern. Few things in the vegetable world present a richer appearance than a field of crimson clover in full flower. It is sometimes drilled at the distance of eight inches in the rows. The quantity of seed is from eighteen to twenty pounds to an acre when sown broadcast; less would be required when drilled. Its chief value is its quick return; as, when sown in autumn, it may be mowed so early the next season, as to leave a favorable opportunity for fallowing the land for wheat. In this respect, however, I cannot perceive that it has any advantage over our common June clover; and I should have great distrust of its endurance under the severe frosts of New England. I have tried it myself upon a small scale, but then it was sown early in the spring.

17. Whin, Furze, or Gorse, (*Ulex Europæus.*) — This is a coarse, evergreen, prickly shrub, growing, in many cases, to a height of some feet, propagating itself, and spreading over large

extents of ground which are left uncultivated, or kept merely as preserves for game. It is singularly productive; it requires to be gathered only as it is wanted to be used; and, when bruised, it furnishes a most nutritious food. I shall give the directions of one farmer in Worcestershire, who finds his account in cultivating it pretty largely, and whose excellent farming I had the pleasure of inspecting.

It is used more extensively in Wales than in any other part of the kingdom. It proves excellent food for horses and cows. I have not learned that it has been used for sheep. The yield of it is represented, even under unfavorable circumstances, to be from eight to twelve tons, per acre, of green feed, and where the soil is favorable, double that quantity. It may be cut in a year after being sown; but it is deemed advisable not to commence cutting it until it is two years old; and then it may be cut every year, and requires no manuring. Some prefer that it should be cropped not oftener than once in two years; but in that case, the plant becomes woody and hard, and is with difficulty cut by a scythe.

There are two kinds of gorse; but that which is called the French gorse, is much preferred; the other kind, being shorter, browner, and much less succulent, is used only in times of extreme scarcity. It is advised to be sown in March or April, and either broadcast, or drilled at a distance in the rows of from eighteen to twenty-four inches. When sown on a side-hill, the rows should be made oblique, rather than directly up and down the hill. The young plants should be kept carefully weeded, as weeds and couch grass are the great enemies to the successful cultivation of the plant; and they should be protected from cattle. Sand, lime, ashes, and cinders, are applied as manure to the plant; but it grows well without manure. The intelligent farmer, in Worcestershire, whose farm I had the pleasure of inspecting, — Richard Spooner, Esq., M. P., — grows it upon an old woodland, cleared up, the soil of which is partly a burning gravel, partly a strong clay, but very dry at bottom, and hilly. The product of half an acre of this land is, on an average, sufficient to keep a cow twenty weeks. On rich, loamy, dry land, he informed me that, in his opinion, double the quantity might be grown. He has now been in the habit of using it more than twenty years.

He sows it as he would clover seed, with a crop of barley or oats, and it is fit to cut the November twelve months after sowing. He mows it afterwards, every year during the winter, as wanted, with a common scythe, close to the ground. On good, dry land, he cuts from seven to ten tons per acre. His principal use of it is for his cows; three bushels and a half per day is sufficient for a cow.

It is first cut through a common chaff-cutter, and then bruised in a mill similar to a cider-mill for grinding apples, the revolving fluted wheels, or nuts, being of iron. He has four-and-twenty cows in one house. Besides the gorse, they are allowed one hundred weight of hay among the whole, — being about four and a half pounds of hay to each cow, — and eight bushels of Swedish turnips, or about twenty pounds of Swedish turnips, to each cow per day. On this, dairy cows are kept in excellent condition, and the butter is remarkably good; fattening-cows on the same allowance will fatten fast. When Swedes are scarce, he substitutes about four pounds of oil cake, per day, to each cow; and as the fattening-cows get forward, he increases the quantity of oil cake gradually, never, however, exceeding twelve pounds of oil cake, per day, to cows of a large size, and that only for the last month. He advises that the gorse should be well ground, and salt mixed with it, at the rate of four ounces, each cow, per day.

In the communication with which he has favored me, he adds, that "it requires no manure, but in its consumption creates a great deal. It will grow on poor, hilly land, if dry, which will not pay for cultivating. When once sown, and well rooted, it yields a great quantity of food for cattle, at a small expense." He has cut over the same ground now for many years. He mows it as soon as the grass feed ceases, and it lasts until the grass comes again. If there is an appearance of snow, he mows a considerable quantity beforehand, and it will keep, laid loosely down in the yard; but it must be bruised as it is wanted, for it will not keep after being bruised, not even over night.

Furze is prepared, in some cases, by being cut in a common chaff-machine, and then passed through two revolving and matched cylinders of iron, like the nuts of a cider-mill; or it is cut, and then laid upon the ground, and rolled by a stone wheel with a broad, flat rim, somewhat resembling the wheel employed by tanners for crushing or grinding their bark. In some cases, two such wheels are fixed to the same axle, which, of course, expedites the work, and both are carried round by a horse or donkey.

An Irish farmer describes his mode of feeding with gorse as follows: "Horses eat it with great avidity, and thrive well on it. I give each working horse a bucket of prepared gorse in the morning, before going out; at dinner time, a feed of boiled potatoes; and at night, two baskets of gorse; neither hay nor oats. Cow-feeding is different; at daylight in the morning, the cattle are driven from their stalls to water — if possible, a running stream. Gorse, if crushed over night, and allowed to lie in a heap, would ferment before morning; the cattle are, therefore, supplied with a feed of mangel-wurzel, while the gorse is undergoing preparation. After breakfast, (ten o'clock,) they get a feed of gorse — as much as they will eat, (should any remain in the trough, it is taken away;) another feed at two o'clock; at four, are again driven to water; and at six, get a large feed to last all night. Cattle will not eat so large a bulk of gorse as of other food, it being so rich that a less quantity suffices. Gorse, after being once established, requires neither tillage, manuring, nor weeding, producing the most nutritious food without imparting any unpleasant flavor to the milk, which is rich and creamy. Twenty acres of gorse would support one hundred head of cattle, for the winter six months, without any other feed, save the morning feed of mangel-wurzel, turnips, or potatoes."*

Three modes of sowing it are prescribed — the first, that of sowing it broadcast, when, by some cultivators, seven or eight, by others, twenty pounds of seed are advised to be used. Others recommend to sow it in drills, eighteen to twenty-four inches apart, when, of course, a much less quantity of seed will suffice. Others advise to sow it first in a seed bed, and transplant it, making the drills as above, and setting the plants six inches asunder in the drills. As the seed is a long time in germinating, and much, on this account, is liable to be lost, it is advised to soak the seed four or five days before sowing, and then let it remain a week or more in a heap, being careful to turn it frequently, to prevent fermentation. The transplanting must be as early as practicable, that the plants may get a sure footing for the winter. Four pounds of seed will be sufficient to supply plants for transplanting.

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* Journal of Royal Agricultural Society, vol. vi. part 11, p. 536.

Having seen the value of this plant, for feeding purposes, on the well-managed farm to which I have referred, I have gone thus at large into its cultivation, believing that the account would be interesting to my American friends. How far its cultivation can be recommended in the United States, experience only can decide. Our severe winters, and deep snows, would be much against it in the Northern States; but there are localities in which, undoubtedly, its cultivation would be beneficial. The obtaining a green succulent feed for our stock in winter, would be a most valuable acquisition. The labor required to prepare it would prove a serious objection in a country where labor is difficult to be procured, and where the almost universal practice is hurry and despatch, and things are but too often only half done.

18. Clovers and Grasses. — The introduction of cultivated grasses, though not recent, is, properly speaking, an improvement of modern husbandry. In British agriculture, various kinds have been introduced; but I shall speak of those which are the most prominent. For the great mass of my readers, botanical descriptions and distinctions would be useless and misplaced; and I shall, therefore, refer to these grasses in terms which are familiar.

In the cultivation of them, two courses are pursued — the one, that of laying down land to permanent pasture or meadow; the other, that of giving them their place for one, two, or three years in a regular rotation. The subject of breaking up permanent pasture, or long-established mowing fields, has been much discussed and controverted; and the decision of the question will depend on many qualifications. The English are strongly opposed to the breaking up of such lands; the Scotch keep very little land, which is capable of being brought under the plough, in permanent grass. Undoubtedly, the largest profit might be obtained from breaking up the land, and letting it take its place in the regular course of crops; but the difficulty to be contended with, where it is to be brought back into permanent pasture or mowing, is that of getting again a firm and substantial sward. This is not so difficult as is supposed; for I have often seen, where the land is well cultivated, and not too severely cropped, and is laid down with a sufficient quantity and variety of seeds, a sward produced by the second year sufficiently compact and strong. One great advantage which would arise from cultivating lands in grass would be, to use up as manure the roots, fragments, and remains, of the grass sward, which have been some time accumulating, and which are in themselves the natural means of enriching the land. The produce of such land in grass is generally much inferior in value to what it would be in a regular rotation. Where, however, it lies in the immediate neighborhood of large cities, from which plenty of manure for top-dressing can be procured, at a reasonable expense, the breaking it up might, with much more reason, be objected to. It may be said, likewise, excepting where it is grown for the market, that hay is in much less request in England than with us. Here turnips or other succulent food is in abundance; chopped straw is substituted for hay; and cattle are fatted, and horses maintained, wholly upon turnips and straw. The system pursued on the model farm of Lord Ducie, in Gloucestershire, is, to have no land in permanent grass, but to bring every portion of the farm under an established rotation of cropping. The same system is pursued in those districts of what may well be called model farming, the county of Northumberland, on the border, and the Lothians, in Scotland.

The expediency of breaking up grass or pasture lands, and converting them into arable land, can only be determined by various considerations, and many of them of a local nature. Many of the lands in England, now devoted to the pasturage of sheep, and yielding a very scanty herbage, the soil being very thin, upon a stratum of chalk, and the aspect exposed, would, if broken up, produce very scanty crops; and it would require many years to restore them again as pasture lands. There are other lands, too, of a sandy character, now yielding in pasture very little feed, which would scarcely repay the cultivation, and perhaps be even more impoverished by it. The dairy farmers, too, are generally persuaded — perhaps a mere prejudice — that good cheese can be made only from old pasture that has been for years undisturbed. Nor can it be safely recommended to break up grass land now yielding a tolerable crop of hay, unless the farmer has the determination and means of improving it by thorough-draining and manuring, lest it should be left in a much worse state than he found it. Indeed, it will be found, in many cases, an enterprise, of which the result, though often beneficial, may disappoint the farmer, and which is not to be entered upon without judgment and practical skill, and a calculation of the resources within reach for ameliorating the land, and increasing its productiveness.

In laying down lands to permanent grass, it is advised to sow large quantities of seed, — from thirty to forty pounds, — and those of a great variety. In the rotation, the principal plants cultivated are the clovers, and the rye and orchard grass, or cocksfoot.

What is called the *cow-clover* is a permanent variety, and valued more for being fed or depastured, than for being made into hay. The common red clover, well known in the United States, is that which is cultivated in the rotation. This is a biennial; and it is, in general, advised to feed it the first year, and to mow it for hay the second year. I have never seen it so large in England as I have seen it at home, which I am inclined to believe arises from their sowing a much greater quantity of seed to the acre than we are accustomed to sow. The quality of the hay is certainly much better, where it is smaller and finer, than with us. Two kinds appear to be cultivated here, as with us — the one resembling what is called our northern clover, a coarse and large variety, and the other, what is called our southern or June clover, a fine variety, and well known and valued by our Connecticut River farmers. I have already spoken of the French red or crimson clover, (*trifolium incarnatum.*) The yellow clover is not valued, though sometimes sown in a mixture of grasses. The Dutch clover is greatly esteemed for pasturage, and, in favorable situations, produces the richest feed possible. The white clover, though excellent as a variety, is not considered the most valuable as a pasture grass; and an objection is made to it, where it too much abounds, that it is apt most severely to scour the cattle.

The making of clover hay, in a climate so variable, or rather so certain, ordinarily, to abound in moisture, requires skill and care. It is never tossed about and spread, but simply turned, and made up, first into small handfuls, and afterwards into cocks; and it sometimes receives many heavy rains without being as much damaged as we should suppose. The low temperature prevents the fermentation which would be likely to take place with us. The cocks, or bunches, are never spread or scattered, but simply turned; and the greatest care is taken that it be not packed away in the stack when wet. It is often in the stack interleaved with straw, which is supposed to answer the double purpose, that of saving the clover from heat and mould, and that of improving the straw for cattle feed, as in this way it imbibes the odor, and perhaps some of the nutritious qualities, of the clover. It was matter of surprise to some farmers, when I informed them, as I have already remarked, that clover hay, with us, was sometimes mowed in the morning, and carried into the barn in the evening of the same day; there, being salted when stowed away, with about a peck of salt to a ton, it has kept perfectly well, and come out in the spring, green and bright, without mould or smoke. The climate of England would hardly admit of this; and the making of hay, especially in Scotland, is a long process, the haying being often delayed by repeated rains. The hay, in general, on these accounts, seems to me much inferior to the hay with us; but I was surprised to find it so very much better, even after repeated wettings and dryings, than I supposed it could possibly be.

Hay, in England, is scarcely ever put in barns. It keeps well in stacks, made up as they are in the neatest manner, and carefully thatched with straw. Nothing can be more beautiful and workmanlike than the manner in which these are made up; and for hay, the long stacks are decidedly preferable to those of a round form, as it is cut down for use, in such case, to more advantage. The formation of a stack, which is often done by women, is a work of much skill, which is the fruit only of practice; the thatching of a stack in the best manner requires both art and experience, and there are men who make it a profession. When well executed, the hay remains for years impervious to wet. During the formation of the stack, — which, when intended to be large, must sometimes wait for several days the progress of the hay-making, — the most careful farmers have a large tarpaulin or canvass covering, to suspend upon poles over the stack, in order to protect it from rain. I refer to these minute circumstances, to illustrate the extreme carefulness with which many of the operations of husbandry are here conducted. When the hay is to be used, a whole stack is never removed to the stables at once, but it is carefully cut down as a loaf of bread might be cut, and always done up and bound in trusses, intended to be of fifty-six pounds each,* and in that way carried to be distributed to the animals. This requires some extra labor; but the farmers find their account in it. How different this is from the careless and wasteful manner in which things are managed with us, where I have often seen horses and oxen standing knee deep in litter of the very best hay, which has fallen and been tossed out of the mangers! The consequence of this extraordinary painstaking is, the most economical management of their products. The animals have a regular allowance, and are not at one time surfeited, and at another time starved; and not a handful of hay is wasted. I have never been quite able to understand the old proverb, that "a penny saved is twopence earned;" but I quite understand the folly of wasting that which is the product of severe toil and expense, and the immorality of throwing away that which the bounty of Heaven bestows for the comfort and sustenance of man or beast. I once heard a minister say, in his sermon, that some persons were charitable in spots; I think, in a similar sense, it may be said that some persons are economical in spots, and that many persons, who will chaffer and haggle half a day to save a sixpence in the price of an article, will often throw away shillings in their neglectful or wasteful use of it.

The difficulties arising from the humidity of the climate, which the farmers in the north and on the western side of the island have to contend with in curing their hay, are such as to call forth all their energy, patience, and perseverance. I shall best illustrate this by giving an extract from a letter with which I have been favored by the Messrs. Drummond, of Stirling, Scotland, the enterprising founders of an Agricultural Museum, embracing specimens of soils, products, seeds, implements, machines, &c. &c., of an almost endless variety, and the inspection of which is full of instruction, and quite worth a journey of hundreds of miles.

"*Rye Grass, or Timothy Hay.* — For several seasons we have practised a very simple and satisfactory method, which enables us to make hay, not only while the sun shines, but while the rain falls, provided the weather be at all breezy.

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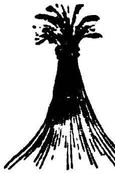
* Trusses of hay, in Smithfield market, are expected to weigh sixty pounds in the early part of the season, and fifty-six pounds after Christmas.

"The mowers are followed by women, who take the newly-cut swath up in regular small sheaves or handfuls, tying them near the top, which is done quickly by a few stalks of the grass. The handful is then held near the top, raised a few feet from the ground, and by giving it a quick motion downwards, the resistance of the air expands the bottom, so as to give it a firm position on the ground, thus:  It will be seen from the form that the rain, as it falls, must run quickly off, while the inside is kept perfectly dry and airy. The process of hay-making then suffers no interruption, and on the outside only during the showers.

"These small sheaves are very soon, without further trouble, ready for being put together in small cocks, keeping all the root ends outwards, and placing one on the top to throw off the wet. In this way, the lower ends are dried, and the whole, without running the smallest risk of spoiling, is soon ready for stacking."

The grass from which it is intended to save the seed, is always done up in sheaves like grain, and remains in small stacks, or, as they are sometimes called, *shocks*, until it is ready to be threshed.

19. **Rye Grass.** — The next grass most cultivated here is the rye grass. Of this there are two prominent kinds, the common, (*lolium perenne*,) and the Italian, (*lolium Italicum*.) Of the former kind there are several varieties, distinguished mainly by the length of their endurance in the soil, some lasting only for a year, others three or four years, and some producing much more herbage than others. The common rye grass has, in my opinion, no advantage over our timothy or herds grass, either in its productiveness, or the quality of the hay. Of the Italian rye grass I have already spoken much at large. It is in high repute, and is invaluable for the alternate husbandry. "Its limited duration, also," says Mr. Lawson, "fits it well for sowing in mixture with the other sorts, intended for permanent pasture, as it dies out, and gives place to the weak and slow-maturing perennial sorts, which are destined ultimately to fill the ground."*

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* "In respect to duration it may be termed a sub-perennial, beyond which title even the most permanent varieties of *lolium perenne* have no claim. In most cases, two seasons of Italian rye grass are all that can with certainty be depended

The experiments of Mr. Dickinson, already very fully detailed, would seem to show that he has fallen upon a most valuable variety; and its superiority, to my mind, was decidedly indicated by a comparison of several specimens growing side by side with it in his grounds. The care with which he is saving the seed, and the great demand for it, promise an extended diffusion. It is believed by many that the saving of seed from crops, the first year of their being sown, has induced the habit of an annual upon the plant; and there is reason to think that much has been, and more may still be, done for the improvement of this, as of other plants, by a careful selection of individual plants which indicate, either greater productiveness, or earlier maturity, or any other valuable property.*

20. ORCHARD GRASS, OR COCKSFOOT, (*Dactylis Glomerata.*) — The next grass much cultivated, and most esteemed, is the orchard grass, or cocksfoot. This grass is well known in the United States, having, it is said, been in the first place imported into England from the United States. It is a very quick grower, and makes most excellent feed and hay. The only objection to it is its disposition to grow in patches, which is, in a degree, prevented by its being frequently mown. A new kind of orchard grass has been introduced, which, for its size and prolificness, has been denominated the *giant cocksfoot*, and has been much commended; but it has not fallen under my observation.

21. BOKHARA, OR TREE CLOVER. — The Bokhara or tree clover, it may be expected that I should allude to, from the celebrity which was at one time given to it. I have seen it cul-

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on, and, in very wet, cold, spongy soils, it will often exhibit a thin stock the second season. Instances have occurred in which as many as five, or even six successive years' produce have been reaped from the same field; but this has arisen more from the ground having been resown in the course of reaping the seed, than from the actual duration of the original plants; the seeds being remarkably-easily separated from the hay, even though not perfectly ripe, which will always render the harvesting of them an operation attended with considerable care and difficulty." — *Lawson.*

* "Like all other plants subjected to artificial culture," say the Messrs. Lawson, "the Italian rye grass is productive of numerous sub-varieties, as a proof of which, we received, in 1838, specimens of no less than fifty distinct spikes, collected in a field near North Berwick."

tivated in small patches, merely as an experiment; but it seems to be too woody for feed. Indeed, a stalk of it was shown to me, with a silver head and ferule to it, which made quite a substantial cane, and might have been considered much rather as the limb or sprout of a tree, than a stem of grass.

There are many other varieties of grass, which are sown, in some cases, for the sake of the variety. Where land is to be laid down to permanent pasture, undoubtedly variety is to be recommended, as most conformable to the system of nature, — which on uncultivated and wild lands, as on the western prairies, for example, seems to multiply varieties almost without limit, — and likewise as adapted in their different natures to different soils and circumstances of climate and aspect. It can scarcely be expected that I should proceed further in the enumeration. The English are remarkably fond of a close turf, and the compactness of the turf in their lawns, and parks, and pleasure grounds, resembling more than any thing else the close texture of velvet, or a Turkey carpet, is always observed; but in order to produce this, it requires that the ground should be filled with a great variety of seeds.

22. **Rib Grass, or Plantain.** — I have observed, in many fields, the narrow-leaved plantain, or ribbed grass, cultivated for herbage. It produces its leaves early, and is relished by cattle, horses, and sheep; but I confess I was not favorably impressed with it, as it spreads much upon the ground, and exclusively occupies a space which, with other plants, would certainly have produced a much larger amount of feed. The common parsley, likewise, is frequently sown with other grasses, at the rate of one pound of seed to an acre. It is eaten by cattle and sheep, and is supposed to be a remedy against the liver rot in sheep. Its habits are biennial, but it will in general perpetuate itself by its own seeds.

23. **Red Top, Herds-Grass.** — That most valuable grass, among us known as the *red top*, (*agrostis vulgaris*,) the improved variety of which is the Rhode Island red top, I have not seen cultivated in England; and timothy or herds grass (*phleum pratense*) is grown, within my observation, to a very small extent. In my opinion, it would be extremely well adapted to

many of their heavy soils, and be found a most profitable grass. I have known, repeatedly, an average yield of more than three tons of this grass to an acre, in well cured hay, in my own country; and, in one case, more than twenty-nine tons, actually weighed, of well-cured hay, principally of herds grass, obtained from six statute acres of land. In Sinclair's scientific table * of the nutritive value of different grasses, he states that the greatest quantity of nutriment in Timothy is found when the plant is perfectly ripe; but the cattle greatly prefer it, when it is cut and cured in the flower; and I am inclined to pay some respect to the decision of judges who seem of right to claim to be competent.

24. MILLET. — I have not seen the millet grass (*millium effusum*) cultivated in England, though it might be, in my opinion, to the greatest advantage. I have obtained three tons to an acre, of as good and nutritious hay as can be grown, from this grass, sown in May. I presented some seed to the Royal Agricultural Society, but I have never yet learned its fate; and my principal object, in referring to it is, that I may commend its cultivation.

25. SOWING GRASS SEED. — The clovers, are, of course, always sown in the spring, upon the grain. The other grasses are sown very frequently in the autumn, but more often, perhaps, in the spring, with a spring crop of oats or barley, the latter crop being generally preferred in the case, as tending to keep the land more open.

The quantity of seed to be sown to an acre differs very much with different individuals. At Teddesley Park, Staffordshire, where one hundred acres are annually sown with Italian rye grass, three bushels per acre are sown with some clover. Where land is laid down to be kept in grass four or five years, the following proportions of different grasses are prescribed: red clover, twelve pounds; trefoil, four pounds; white, six pounds; rib grass, or narrow-leaved plantain, two pounds; and two pecks of perennial rye grass. I feel a good deal of diffidence in giving these quantities, as the practice of different farmers is so various.

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* Hortus Gramineus Woburnensis.

Some recommend as much as twenty pounds of each of the red, white, and yellow clovers, with half that weight of rib grass, and three bushels of rye grass, per acre. This, of course, involves a large expense.

One of the most eminent farmers in the kingdom, whose farming seemed to me to combine, in as high a degree as I have any where seen, experience, intelligent observation, and practical skill, Mr. Stirling, of Glenbervie, Stirlingshire, gave me the subjoined list and quantities, as his rule, where land was to be laid down to permanent pasture: nine pounds of fox-tail; two and a half pounds of cock's-foot; three and a half pounds of meadow fescue; four and a half pounds of hard fescue; four and a half pounds of Italian rye grass; three pounds of red clover; four pounds of yellow clover; four pounds of white clover; eight pounds of timothy; two pounds of rib grass; one pound of yarrow. He says that, after repeated trials, he has found this mixture to answer better than any other. He sows red clover, and Italian rye grass, though shortlived grasses, for permanent pasture, because, he says, it is too expensive to seed the land, for the first year, with the perennial grasses, which *sheep* prefer, and because, in consequence, it carries more stock, and he has better pasture the following year. He is of opinion, that all grasses grow better when red clover is sown among them. The Italian rye grass gives the earliest bite, and helps to occupy the space, which would otherwise be filled with daisies and other weeds. He sows yellow clover, which is not, in general, a favorite grass, because, upon trial, when he sowed a field of grass, one half mixed with yellow clover and the other with white, the sheep preferred that which was sown with yellow. For neat cattle, he says, he should recommend the perennial rye grass, in addition; and he should, for milch cows, omit the yarrow, as, in excess, it imparts a disagreeable flavor to the butter. Mr. Stirling has made some valuable experiments in regard to the depth at which grass seeds should be sown, the results of which I had the pleasure to witness. The difference, in the same field, where the grass seeds were scarcely covered, and where they were harrowed in, was quite obvious, and decidedly against covering them deeply. He says that "a quarter of an inch is too deep for the *poa nemoralis*, (wood-meadow grass,) and timothy, as they grow more freely when scarcely covered." He adds that "grass seeds, in general, are most vigorous at three quarters of an inch deep, with the exception of cock's-foot, rib grass, and red clover." He would recommend, he says, to all who wish to avoid disappointment, to prove *all* their grass, clover, and turnip seed, before using, by sowing a small weight in a pot, and placing it in a warm situation, and counting the plants which come up; and they will find that a bushel of rye grass seed, weighing twenty-eight or thirty pounds, may be cheaper than one weighing eighteen or twenty pounds, though the price be considerably more.

26. HOPS. — The next great article of cultivation to which I shall refer is that of hops. In 1804, the extent of ground devoted to the cultivation of hops amounted to thirty-five thousand acres; and it is at the present time supposed to have greatly increased. In the county of Kent, which is the part of England in which the hop is most extensively cultivated, — said, indeed, to embrace half the land in hops in the kingdom, — the number of acres exceeded twenty-two thousand. From the immense quantities of beer consumed in England, it is obvious that the demand for hops and barley must be very great. Hops are used in beer for two purposes; — first, to correct the excessive sweetness of the malt, and to give it a pleasant flavor; and second to preserve it sound.

The hop cultivation is managed with great skill in Kent, and in parts of Surrey, where I have had the pleasure of seeing it in its perfection. One individual had one hundred and fifty acres in hops. The ground for hops should be a rich and mellow soil; and, in general, the farmers are of opinion, that, in order to produce the best quality of hops, the substratum of the soil should be calcareous. That the plant requires a deep culture is evident from the roots having been traced to a distance of twenty feet. The land requires to be trench-ploughed, or spaded to the depth of two spits. The former mode is the least expensive at first; the latter mode will prove the most eligible in the end. The ground, indeed, should be subjected to the best garden cultivation.

The hills are to be marked out in right lines, at a distance of six or eight feet apart. The spot which is to receive the plants should be rendered as mellow and rich as may be, by careful digging. Three or four plants may be placed in a hill. These may be procured from the clippings of the vines, in March; or from what gardeners call layers; or from seed. The latter mode is considered preferable. In hops, the male and female plant are distinct; but many cultivators reject and extirpate the former as barren. It is necessary that they should grow together — that is, a due proportion of the male plants should be cultivated in order to give "that energy and vitality to the seed without which it would not produce its kind. This it is which gives weight to the hop, which gives the fine aromatic bitter to the production of the vine, and more fully to the seed; — the petal or leaf of the flower containing but little of the astringent quality of the hop. Cultivators of the hop are urged, therefore, to have many male plants on the ground, at least, one to fifty female plants, and 'particularly to encourage them around their plantation, in the hedges, where no ground will be lost.'

"The hop plants raised from seed surpass those which have been raised from cuttings, their luxuriant growth enabling them to withstand the effects of blight. They are found to have a seed at the bottom of every petal of the flower, of a most pungent aromatic flavor; while those hops grown in the usual way, without the necessary quantity of male plants, have scarcely any seed, and they are mostly abortive. In fact, seed gives weight and flavor to the hop, and constitutes the vitality of the plant, or the condition or strength of the hop; and where there is the most seed, there will be the most condition. We therefore say that the grand object in hop-growing should be to get as much seed as possible." * These are the important suggestions of an experienced and competent cultivator.

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* "The weight of hop leaves, without the seed, having been accurately ascertained, those grown at Lewisham, being the fourth year from the sowing of the seed, and having a male plant close to them, weighed at the rate of thirty-six pounds per bushel; and the same quantity (by old measure) from Shoreham, raised from cuttings, and grown near male plants, weighed at the rate of thirty-five pounds per bushel. The hop leaves without seed, from a place at Oxford where the male plants are always eradicated, weighed at the rate of twenty-two pounds per bushel, when closely pressed."

"Hop seeds being severally put into rainwater, most of those produced by plants raised from seeds, and grown near male plants, sank in the water; while most of those grown in grounds that had not any male plant near them, and which had been raised from cuttings, swam on its surface." — *Golden Farmer.*

The vines, or bines, grown from seed will be fit to be poled the third year; those from cuttings or layers, the second year. The business of the first year is, to keep the ground as clean as possible, and the plants well earthed up. Though they are not poled the first year, yet a stick is put into the ground, to which they are tied and trained. The hop is an enduring plant, and some fields in Kent have been in hops beyond the memory of persons now living; but it is deemed best to renew them once in twelve or fifteen years.

The hills require, every spring, to be opened and carefully trimmed — the last year's shoots to within an inch of the main stem, and the suckers close to it. In some cases, they are manured only once in two years. Farm-yard dung is an excellent manure for them; and the clippings, or waste, of woollen mills, called *shoddy*, are much valued and used. The land on the borders of the chalk formation is much preferred for the growth of hops.

There are several different kinds grown, and distinguished, in different places, by different names. These are the *grape*, the *white bines*, and the *golden*, vulgarly called the *goldings*. The white bines are most esteemed in Farnham, Surrey, and there are no hops in the market, which bring a better price than the Farnham.

The poles used for the hops are of chestnut, ash, or larch, and are cultivated in plantations, oftentimes, by the hop-growers themselves; and these plantations admit of being cut once in ten years. Beech, birch, and elder, are quite inferior, though sometimes used. The poles are from twelve to sixteen feet; but it is said to be an error to have them too long, as the bine becomes feeble by too much extending itself. With a view to avoid the effects of violent winds, the plantation is sometimes hoodwinked by a row of trees upon the side most exposed; and to give more firmness, one cultivator has taken pains to have the poles strengthened by an iron wire extending from one to another on the top. The experiment was considered of doubtful advantage.*

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* "*Improvements in Hop-poling.* — Mr. Knowles's plantation (Kent) consists of about forty-two acres, lying on a very beautiful slope of the Ragstone Hills, having a warm aspect and an excellent soil, which, however, evidently owes much of its productiveness to liberal dressing and spirited cultivation. Mr. Knowles digs his land twice — once early in the winter, and again at the usual period in the spring,

The plantations, when it can be safely done, are cultivated by a horse hoe, or plough, and every effort is made to keep the plantation free from weeds. The plant is subject to blight, and destruction from aphides, and a good crop is judged to be obtained scarcely oftener than one year in five. An acre contains about one thousand hills, and the yield may be put down at from five hundred to one thousand pounds per acre. In a series of ten years, from 1835 to 1844, the return of one plantation, as given in Mr. Buckland's valuable Report on the Agriculture of Kent, is as subjoined: —

	Cwt.	qr.	lbs.				Cwt.	qr.	lbs.		
1835, ...	11	1	23	per	acre.	1840, ...	0	2	15	per	acre.
1836, ...	8	0	18	"	"	1841, ...	9	3	18	"	"
1837, ...	7	1	16	"	"	1842, ...	10	0	19	"	"
1838, ...	11	2	23	"	"	1843, ...	10	3	00	"	"
1839, ...	15	1	6	"	"	1844, ...	3	0	9	"	"

The price of hops fluctuates between very wide ranges. The expense of cultivation in Surrey was stated to me, exclusive of

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nidgets or harrows all through the summer, and generally farms upon four good maxims, which perhaps may be more easily remembered by the reader, if thrown into a distich.

> 'Cut early, pick late,
> Well mend, and cultivate.'

This new plan of poling was exhibited in about seven acres of splendid goldings, at the back of Mr. Knowles's residence. The weather sides of this piece had been poled four hills deep, with handsome, straight, twenty-one feet, large poles, in rows. These were lashed to similar poles placed horizontally across them, about eight feet high, from end to end of the hills; and the rows of hills were similarly bound to each other by poles placed from the outside rows to the inside ones. By this means a phalanx of poles offers a sufficient resistance to the wind to shelter the whole ground. Mr. Knowles was led to devise this plan as a means of shelter. In one year, he calculates that he lost a bag an acre of his goldings, from the effects of the wind — a loss amounting to about one hundred and forty pounds. This arrangement has been found a complete protection. Another result has been obtained from it, which was scarcely anticipated, viz., a very great improvement in the quantity of hops grown on the outside poles. In many cases, these poles are covered with from thirteen feet to fourteen feet of hops from the top, besides the cross poles being clustered most heavily, thus clearly showing the great advantage of keeping the plants and poles firmly fixed, instead of allowing them to swing about. The increased expense of poling a ground throughout, in this way, is estimated at about thirty shillings per acre, besides an extra man required in pulling. The saving in windy seasons would, doubtless, be very considerable." — *Maidstone Gazette.*

rent, at thirty pounds, or one hundred and fifty dollars, per acre; but by many it is estimated much higher. Twenty pounds, or one hundred dollars, are sometimes paid as rent, per acre, for hop land. In spite of all these uncertainties, — perhaps the more on account of them, — men full of adventure plunge with eagerness into the cultivation; and the betting upon the amount of excise duty paid to the government — which, of course, is the index of the amount of product — is prevalent throughout the hop district, from the largest grower to even the lowest picker and packer.

It is desirable that only the same kind of hops should be planted in a field, so that the ripening may be uniform. It is important that the hops should be of a bright golden color, and full of aroma, or what is here called *lupulin*, which gives its value to the hop. The bines, at the season of harvest, are cut about three feet from the ground, — lower than that is injurious to the plant, from excessive bleeding; — and the poles are then lifted from the ground, and laid upon frames, when the picking begins. This, in favorable weather, is a merry season; and pickers come from distant places, men, women, and children, (many of them of the gypsy race,) encamping in the neighborhood under their rude tents, constructed of hop poles covered with a coarse blanket, with loose straw for their beds; and others, men, women, and children, are glad to find a lodging in some outhouse or shed, like pigs in a sty, with little regard to the decencies of life. In general, they provide for themselves; though the owner is careful to have a good supply of bread and potatoes, as they may be required.

The hops are picked in large baskets, which are gauged by marks; and an accountant is always in the field, to oversee the picking. They are sorted as they are gathered, the discolored and inferior being put by themselves. The price for picking varies from two pence to three and a half pence per bushel, or from four to seven cents. From five to seven bushels is considered a fâir day's work, though I saw one woman, who had, in one day, picked eighteen bushels. Whole families, especially mothers and children, capable of doing any thing, are in requisition; and the babies are laid upon the ground, to take their first lessons in hop-picking, as they may be able to receive them.

The hops, being picked, are at once conveyed to the kilns, or, as they are called, *oasts*, to be dried without delay. A night's delay would be extremely injurious. The most approved kilns are now made of brick, of a conical or sugar-loaf form; "that is, a circular kiln of brick-work, from fifteen to eighteen feet diameter, with rafters, twenty-four to twenty-seven feet long, leaving a round opening in the apex of the roof, surmounted by a movable cowl, (or swinging ventilator,) the object of which is to allow the vapor of the drying hops freely to escape. The drying-floor should be at least ten or twelve feet from the fires; it is usually made of stout lathes of fir, about two inches apart, covered with a horse-hair cloth, upon which the hops are evenly spread. The improved modern practice consists in having one or more large openings or fires to one kiln, and to admit plenty of cool air from without, the draught being regulated by means of flues and sliding doors. The fuel used in drying hops is, in all cases, charcoal or coke, with some anthracite."* They are laid upon the kiln from six inches to a foot thick, and are about twelve hours in being dried.

A large amount of sulphur is now used in drying hops, and is deemed most important to their color. Great prejudices existed at first against its use, but it is not now objected to by the brewers. The hops remain a few days, after being taken from the kiln, in the storehouses, before being packed. The packing has been repeatedly attempted by machinery, but none found equal to the human machine. A bag, therefore, is suspended through the floor of the room, in which the hops are deposited, by a hoop, which forms a temporary rim to it; two large handfuls are tied up in the corners of the bottom of the bag, to render the handling of the bag more convenient; and the packer then gets into the bag, and draws the hops, — which are shoved towards him, on the floor, by a child, — with his arms, into the bag, and treads them with his feet as closely as possible. This is most severe and awkward labor, and he receives from 9 d. to 1 s. per cwt. for packing. Every part of the body, arms, and legs, is brought into violent motion, and the effort resembles what one would conceive it might be with a man trying to shake off his skin. A bag or pocket contains about 2½ cwt. They have established markets for hops on fixed days, where buyers and sellers attend, and the sample bags are exhibited. The great complaint made of the American hops, in the English market, — where they are considered greatly inferior to those grown among themselves, — is, that they are not well cured, nor assorted. The profits of the cultivation of hops are sometimes very large. A friend told me that he had known one hundred pounds, as profit, realized from a single acre. But such is a very rare example. Many good fortunes have been made in the business, but very severe losses have been sustained; and the great uncertainties of the result are sufficient to deter any, but the most bold and enterprising.

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* Buckland's Report of Kent.

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CVII. — FLAX.

1. General Views. — The cultivation of flax has prevailed to a very limited degree in England; I saw nothing of it in Scotland; but in Ireland it is pursued to a considerable extent, and yearly with increasing success. Two or three things have served, heretofore, to hinder its cultivation. The first has been the opinion, that it is a very scourging or exhausting crop, and the second, the difficulties of curing it, and the inferior quality of the article, when produced. The want of a market, likewise, for the produce, operated against its cultivation. Out of the cultivation has arisen the market; and the product and the demand appear to be going on with an equal step.

With respect to the exhaustion of the soil, if reliance is to be placed upon chemical analysis, then the fibre of the plant, the flax properly so speaking, is wholly derived from the atmosphere. This is the result come to by the eminent Dr. Kane, professor of chemistry, in Dublin, upon a chemical analysis of the flax plant; and therefore, if the other portions of the plant are, in any form, returned to the soil, there will be no impoverishment, and flax may be as often cultivated upon the same soil as any other crop. How far this question may be considered as settled by such an examination, I shall leave others to determine; but experience proves that, where the land is properly managed, flax may, with success, be much oftener repeated on the same land, than it was formerly supposed advisable to do it. In what form these portions of the flax-plant are to be made available as manure, I shall presently show.*

The cultivation of flax is very much on the increase in Ireland. In 1841, the amount of crop, as ascertained, was twenty-five thousand tons; in 1843, it exceeded thirty-six thousand tons; and while the quantity produced is constantly on the increase, the quality of the article is decidedly, and very greatly, improved. The flax grown in Belgium, from its fineness and color, has been deemed much superior to any other. Much of the flax now grown in Ireland, of which I saw samples at their great cattle show, is probably surpassed by none. This improvement has been effected, undoubtedly, in a considerable degree, by the establishment of a society for the improvement of the growth of flax in Ireland, composed of some of the first men in Ireland, in point of intelligence, rank, wealth, and public spirit, who have obtained and circulated the fullest information in respect to the growth of flax, and the proper management of the crop; who have offered liberal premiums for the best samples which should be produced, and for improved machines for dressing and cleaning the crop; and who have especially imported several skilful flax-growers and managers from Belgium, in order to give direct and practical instructions to the Irish cultivators, as to the most improved modes of growing, cleaning, and dressing the crop, prevalent in their country. No method for the advancement of these objects could be more judicious.

Having seen many of the plantations of flax in Ireland, and believing that the crop may be of great value in the United States, in connection with the proper application of the seed, I shall give, in as condensed a form as I am able, the information which I have received respecting it. I am quite aware how greatly the extended growth and cheapness of cotton has superseded the use of linen; but when the vastly-superior comfort of linen, especially in hot weather, is considered, its greater durability and strength, so requisite for many purposes, its important uses as twine and thread, and its indispensable use in those very delicate fabrics for which increasing wealth and luxury are constantly making new demands, we may expect that the cultivation of it in the United States will be much extended.

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* "This fibre, which constitutes the entire money value of the flax crop, is produced during the life of the plant, by the elements of the atmosphere; and the materials taken from the manure and the soil are, in reality, employed by the plant in organizing substances which do not make any return to the farmer, but which are, on the contrary, under certain circumstances, considered to be positively a disadvantage. It is, therefore, of importance, that it should be understood that, by a proper system, the growth of flax and similar fibre crops should be destitute of all exhausting influence; that the materials drawn from the soil by such a crop should be found in the waste products of its manufacture, and should be available by being returned to the soil, to restore it to its original condition of fertility." — *Professor Kane.*

2. Soil, and Preparation of the Soil. — The best soil for the cultivation of flax is stated to be a deep, rich loam, with a strong subsoil; and the land should be thoroughly drained, and so laid as not to retain water upon the surface. Wetness of the soil, or standing water upon it, is most fatal to the flax crop. A calcareous soil is never to be chosen for flax, lime being unfriendly to the plant. The best crop to which flax can succeed is a grain crop, such as wheat or oats. It should not be manured the same year in which it is sown, but the manure should have been applied with a previous crop. It is desirable that the land should be deeply ploughed, or subsoiled, as the roots of flax penetrate to a considerable depth, and above all, that it should be thoroughly cleansed from weeds. Fall ploughing is recommended, and two ploughings in the spring, that the land may be brought into a fine tilth. The land should be well harrowed and rolled; then harrowed with a light or seed-harrow, the seed sown, and again harrowed so as to give it a very light covering, as, if buried deep, the seed will perish; and then again rolled, if the ground is light, but not on heavy land, that the ground may be left smooth and consolidated. The rolling after sowing, however, is much condemned by some successful and experienced flax-growers.

3. Seed and Sowing. — The seed should be plump, shining, and heavy, and should be, as far as possible, cleaned from the seeds of all weeds. Two and a half bushels of seed are recommended to a statute acre. I may remark in passing, that the use of American seed is much discouraged in Ireland, and farmers are strongly cautioned against sowing it, as producing a coarse, branchy kind of flax, and of very inferior quality. This fact may prove of great importance to the farmers of the United States.

The best flax-seed for sowing is reputed to come from Riga, though Dutch seed is much approved. Thick sowing is strongly urged, as it is desirable to have the flax shoot up in a straight stem, with as little branching as may be, for the finer the stem the finer the flax or fibre. Less seed is produced in this way, but the flax itself is more valuable. The eminent manufacturers, the Messrs. Marshall & Co., of Leeds, give it as their opinion, "that the cultivation of the flax for the fibre is of far more importance than for the seed; and that by sowing seed suitable to produce fine flax, and sowing it thick, (say three to three and a half bushels, per acre,) the farmer, though he sacrifices something in the value of the seed produced, will get a more remunerating crop from his land than he now obtains." This is a manufacturer's view of the question; when the value of the seed for feeding animals is considered, and the contribution which, in this way, it yields to the enriching of the land, the farmer may come to a somewhat different conclusion.

The sowing of clover or grass seed is strongly objected to, as injuring the root ends of the flax. It is desirable to sow as early as convenient, as the earliest sown proves, always, the best crop. It is understood that flax should never follow turnips, or any of the turnip tribe; and it may occur in a rotation twice in ten years, or once in seven or eight years.

4. WEEDING. — If the land has been thoroughly cleaned before sowing, the weeds will give little trouble; but the crop will require weeding; and in order to do this, great care must be taken not to twist or bruise the plant, and to weed facing the wind, so that it may assist the plant to recover its upright position. Much injury may be done to the plant by carelessness in weeding, which is performed usually by women and children, creeping upon all fours, and so bearing more lightly upon the plant than if they stood upon their feet.

5. PULLING. — It is important to determine the best time for pulling the flax. The fibre is of a better quality, if pulled before the seed is quite ripe. If pulled too soon, there is much waste in preparing it; if pulled too late, the fibre becomes coarse. "The best time for pulling is when the seeds are beginning to change from a green to a pale brown color, and the

stalk to become yellow, for about two thirds of its height from the ground." An eminent cultivator gives this advice, in regard to determining the ripeness of flax: "Try the flax every day, when approaching ripeness, by cutting the ripest capsule, on an average stock, across, (horizontally;) and when the seeds have changed from the white milky substance, which they first show to a greenish color, pretty firm, then is the time to pull. The old prejudice in favor of much ripening is most injurious, even as regards quantity; and the usual test of the stalk stripping at the root, and turning yellow, should not be depended on." The prevalent practice is, almost universally, to overripen the crop.

If the ground has been properly prepared, by draining and levelling, the crop may be expected to be of equal length; but where this is not the case, then the puller should be directed to seize the longest stems in his hand, and, having pulled them, lay them by themselves, and next pull the shorter stems, keeping each handful separate, as it is of great importance to keep the flax of equal length. It is urged, as very essential, to keep the flax even, like a brush, at the root-ends; and in none of the after processes should the short and the long be intermixed.

6. Rippling. — The rippling of flax is a process by which the seed bolls are separated from the stalk. This is done by drawing them through an iron comb, which is formed with iron teeth fastened into a board or bench. The seed bolls are sometimes dried in kilns; but by this process they are very apt to be injured, and their valuable properties reduced. They should, therefore, be dried in the sun, and the seed threshed out. The light seed, and the bolls or chaff, are to be used as feed for stock, for which purpose they are eminently nutritious.

7. Steeping. — The rippling or combing off the seed being performed, the next step is that of steeping the flax. This is to be conveyed, then, as soon as may be, to a pond of water, quite free from all impurities, and especially from all mineral mixtures, which are always pernicious to the plant. If the water is spring water, it is advised to let the pond be filled some days before the steeping, that it may have the advantage of the sun upon it. The flax is then to be laid in the pond, two or more layers in

thickness, and covered closely with sods, that it may be kept down under the water, away from the air and light, yet without sinking to the bottom. In Belgium, crates are used, in which the flax is packed away, in bundles of about twelve pounds' weight each, and these are sunk, and kept down by weights, in the water, with stones underneath, to prevent their resting upon the bottom. It is not objected that a stream of water should pass over the pond; but this, though sometimes recommended, is incompatible with saving the liquor of the steep for manure, for which purpose, as I have seen, it is eminently valuable.

From eight to twelve days is considered a sufficient length of time for the steeping of the plant; though one Irish cultivator states, that where, by accident, some of his flax was left in the water for eighteen days, it was much superior to that which remained only thirteen days. The test given to determine its fitness to be taken out of the water is as follows: "Try some stalks of average thickness, by breaking the woody part, in two places, about six inches apart, at the middle of the stalk; catch the broken bit of wood; and if it will pull freely out downwards for that length, without breaking or tearing the fibre, and with none of the fibre adhering to it, it is ready to be taken out. Make this trial over, six hours after fermentation subsides; for sometimes the change is rapid." The flax is then to be removed from the pool with great care; and after being set up on end, to drain, for a few hours, by placing the bundles close to each other, it is then to be spread out upon a grass field, not upon the field on which it grew, to complete the process. Short pasture ground is best for this purpose; and it must be spread thinly, so that one stalk may not overlay another, and as evenly as can be done. It is to be turned two or three times, while on the ground, that it may not acquire different shades of color by the action of the sun.

When the wood breaks easily, and separates from the fibre, it is then ready to be taken up. This may be determined by the hand, or by trying some in a machine. It is important, in taking up, to keep the ends even. It is to be tied up in small bundles, and put away in small stacks, loosely built up, or under cover in a barn or shed, ready for being broken and scutched. Some persons attempt to dry their flax by fire; but such a method is strongly condemned, as the flax is always injured, its oily portions being dried out by fire.

8. The Courtray Method.—On the Continent, at Courtray, from which some of the best flax is obtained, they practise a method of curing their flax which has been adopted in Ireland, with much success, but which involves more trouble than the usual process. "As soon as pulled, the flax is stooked, without binding it. The handfuls are set up resting against each other, the root ends spread out, and the tops joining like the letter A, forming stooks about eight feet long, with a short strap keeping the ends firm. In this way it will resist wind and rain well, and dry fast. In eight or ten days, it may be bound up in small bundles, carried to the ripple, and steeped; or it may be stacked in the field or put into a barn, the seed to be taken off at leisure, in the winter, and the flax steeped in the ensuing spring." This leaves the farmer an opportunity of choosing the most leisure and convenient season for attending to his flax product. It is understood that flax improves in the stack for two or three years; but the danger of the flax suffering from being put away, in a stack, green, is to be considered; and the rippling and steeping it immediately after being pulled may prove a considerable saving of labor over that of stacking it at first.

9. Breaking and Scutching. — Machines have been invented, in Ireland, for breaking and scutching, or *hatchelling*, or *swingling*, as it is called in the United States, the flax crop. The break seems fitted to do its work well. It is composed of three cylindrical rollers, grooved like the nuts of a cider-mill, and revolving against each other. The scutching machine has several arms made to perform about a hundred and eighty revolutions in a minute; but the objection to it is, that it drives the wood or hull into the flax, and does not leave it in that clean and even state which is produced by the hand. There can be little doubt that experience and ingenuity will improve these, or invent other machines, which may prove more suitable to the object. It certainly would not be difficult to make an improvement upon the method of breaking flax practised in Ireland before the improved machines came to be invented, when it was the custom

to break it with a cart-wheel upon the road, and when they had no wheel, "the cultivator would accost a gentleman, passing in a gig, with a 'Please yer honor, will ye gie uz a rowl?'"

10. Uses of the Seed.—I have already suggested the conclusion to which many intelligent farmers have arrived, that flax is not a particularly exhausting crop, *when the refuse of the crop is returned to the soil, and the seed applied to the feeding of animals.* I saw very remarkable effects produced in a field of oats, where the water in which the flax had been steeped was applied as a manure. In my opinion, no manure could have been more efficacious; and so it has proved wherever it has been tried. But yet greater benefits are calculated upon, to be derived from the seed when used as feed for fattening stock, and in their manure, for enriching the land. One of the most successful farmers I have met with on this side of the water, and one whose premises, in every department, exhibited the strongest proofs of industry, skill, and intelligence,—and who, more than all this, has risen from the humble position of a tenant farmer, with very small means, to that of an independent landholder, and has brought up a large family, and planted three sons, as tenant farmers, around him, with ample capital to manage their farms,—attributed much of his successful husbandry to a very liberal supply of linseed oil cake to his fatting cattle and sheep. His farm consisted of two hundred and fifty acres, and he annually expended two hundred and twenty-five pounds, or more than one thousand one hundred dollars, for oil cake. This enabled him to turn off his stock in good condition; this gave him ample means of enriching his land; and this laid the foundation of some of the best crops grown in the country. The opinion of an experimenter so observing and successful must have great weight in the case. Many farmers consume fifty and one hundred tons per year, and some, within my knowledge, to the amount of two hundred tons per year. But if the linseed oil cake is valuable, still more valuable is the seed itself, from which the cake is formed, before the oil is expressed. The seed is not a new article to be used in the feeding of stock, and its great efficacy in fattening both cattle and sheep, and in increasing the secretions of milk, when given to cows, I have myself repeatedly experienced.

11. **Mr. Warne's Method.** — It is not best, however, to use it in a crude state, but either to reduce it to a rich jelly or mucilage by boiling, or, after having done so, by the addition of meal, to form it into a rich paste, of which cattle soon become very fond. Mr. John Warne, of Trimmingham, in Norfolk county, whom I have the pleasure of knowing, a highly intelligent and enterprising farmer, has greatly interested himself to induce the farmers of England to cultivate flax largely, not for the fibre only, but for the seed, as feed for cattle, and in this way to obtain the most effectual means of enriching their land, and thus save at home some portion of those immense sums which are now expended upon the importation of manures from abroad.

Having had repeated communications with Mr. Warne, I shall give some account of the management which he pursues in the use of seed for fattening. He has sheds for his stock, which he divides into separate compartments, or stalls, or, as he calls them, *boxes*. Each box is designed to contain one fatting animal. It is intended to be about nine feet square, and the earth is dug out so as to form a depth of about two feet from the surface, walled in with brick, and the bottom made tight. The animal to be fatted is placed in this box, and copiously littered with straw, of which an ample supply is furnished daily, that he may have a dry bed to lie down upon, and that as much of the manure as possible may be absorbed by the straw. The animal is not taken out of the box during the process of being fattened; and, besides such long feed as may be given, he is supplied with this linseed paste, made after the recipe subjoined.

"*Compound for Sheep.* — Let a quantity of linseed be reduced to a fine meal, and barley be passed through a crushing machine, with smooth cylinders. Put a hundred and sixty-eight pounds of water into an iron cauldron; as soon as it boils, not before, stir in twenty-one pounds of linseed meal; continue to stir it for about five minutes; then let sixty-three pounds of the crushed barley be sprinkled upon the boiling mucilage, and rapidly stirred in. After the whole has been carefully incorporated, the fire may be suffered to go out. The mass will continue to simmer until the barley has absorbed the mucilage; and the compound, when cold, may be given to the sheep."

"For bullocks, the same process is to be observed; but the barley, in this case, must be ground into fine meal, and the quantity of water somewhat reduced. In this case, the fire must be extinguished, for the reason, that flattened barley requires heat to carry on absorption, while meal is sufficiently cooked by immersion.

It may be asked, Why should not the compound for sheep be equally adapted to bullocks? I answer," (he adds,) "that sheep are close, ruminating animals, and pass nothing undigested, while with bullocks, it is far otherwise. On the compound being removed into tubs, it must be excluded from the air, to prevent its becoming rancid."

I have given the directions nearly in Mr. Warne's own words; but I see no reason why the barley may not, in both cases, be at once reduced to meal, or why the linseed and the grain (whether barley, rye, or maize) may not, in proper proportions, be at first ground together, in which case they are likely to be most intimately incorporated; and the experienced manager will himself soon be able to determine, from his own observation, the quantity of water the meal will take up, and form a suitable and nutritious compound, without difficulty. The points important seem to me to be, that both seed and grain should be ground, and both sufficiently cooked. Mr. Warne adds, in another place, "A bullock may be allowed, in general, to eat as much cake in a day as he pleases; but a nice regard must always be had to the quantity of linseed placed before him, and especially to the oil. Neither oil nor linseed should be used in a crude state, but formed into mucilage, by being boiled in water. The seed must first be reduced to fine meal; one pound and a half of which, stirred into twelve pounds of water, while it is boiling, with four pounds and a half of barley, beans, or pea meal, and given to a bullock of between forty and fifty stone, (fourteen pounds,) every day, will, in addition to Swedish turnips, be quite sufficient, or, perhaps, rather more than he would be inclined to eat. This small quantity of linseed will act well on the stomach; and the bullocks will thrive, and fatten, in a degree that can scarcely be credited, except by the person who tries the experiment. The quantity of seed may be increased, after the animal has been accustomed to it for some time, but, I believe, to no great extent." *

I place the fullest confidence in these statements of Mr. Warne. From my own experience and observation, I am convinced that no more nutritious or fattening food can be given to animals, (swine excepted, as it gives an unpleasant taste to the pork,) than cooked linseed or flaxseed jelly, in certain proportions; and it may be mixed with cut hay, or with various other articles of food, with equal success.

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* Warne on the Flax Crop, and Use of the Seed, p. 120.

One great object in Mr. Warne's arrangements is to secure a good supply of manure. The manure is not removed until the fatting of the animal is completed; and then, if sufficient litter has been supplied, it is obvious that the manure, being protected from the sun and rain, and all its liquid portions being retained and absorbed in the straw, must be of the richest quality. Its very superior efficacy cannot be doubted.

I ought not to quit this subject without reverting to some statements respecting the effect of flaxseed, or rather the refuse, or waste, of flax, upon cows in milk. A respectable Irish farmer testifies that, from one field of ten acres, he had one hundred and eighty-five bushels of bows for feeding, that is, seed in the capsules, and other refuse from the flax. After feeding a cow, which gave only three quarts of milk, a short time, upon this refuse, she soon increased her milk to nine quarts per day. Another farmer testifies to a similar fact, where a cow, which only gave two quarts, was improved so as to give nine; and, upon discontinuing this food, she went back to four quarts. These instances, being well authenticated, seem entitled to consideration.

Many farmers in the United States will, I think, deem this subject worthy their consideration. The cultivation of flax has been very little extended, and within my experience has, proportionately with the population, been lessened. The foot spinning-wheel of the industrious operative, formerly so pleasing an ornament at the cottage door, is now to be found only among the useless lumber of the garret. That, in the present daily increasing triumphs of machinery, hand-spinning, or house-weaving, should ever come back, it would be quite idle to expect. Habits and practices much less useful, and much less desirable, may take their place; but I should certainly be glad to see an increased use of linen fabrics, on the ground both of comfort and durability.

12. AVERAGE PRODUCE, AND USES OF THE PRODUCE. — The average yield of a well-cultivated crop of flax ranges between five hundred and six hundred pounds; and the quantity of seed to an acre may be about fifteen bushels. The chaff and light seed are saved by some, and when cooked are deemed valuable food for stock.

In the reports of the Irish Society for the Growth of Flax in Ireland, a statement is given of the application of the produce of three acres of flax, the purposes for which it is used, the processes through which it passes, and the amount of useful and profitable labor which it puts in motion, which I think cannot fail to interest my readers.

"*Produce of three Acres of Flax.* — 100 stones, at 15 s., = £75, each stone calculated to produce 5½ lbs. of *dressed* flax, — in all 550 lbs., — spun to 30 hanks to the lb. will produce 16,500 hanks. About 158 females will be employed twelve months in spinning, at the rate of two hanks per week, (sixteen working days;) wages for spinning each hank, about 1 s. 8 d. or nearly 7 d. per diem for each spinner. This quantity of yarn would make 210 webs of cambric pocket-handkerchiefs, each web containing five dozen. About 18 weavers would be twelve months weaving this quantity, allowing each man a month for each web (17½ weavers exactly;) wages per web, £2, or from 9 s. 6 d. to 10 s. a man, per week. About 40 females would be employed twelve months in needlework, (hemstitch or veining;) each could do *one* handkerchief on each working day; wages, 8 s. per dozen, or 8 d per day. The goods, when finished, would be worth £2 10 s. per dozen.

"158	spinners, 12 months, or 52 weeks, at about 3 s. 4 d. per week, ...	£1,369	6	8
18	weavers, 12 months, 210 webs, at £2 per web, ...	420	0	0
40	needlewomen, 52 weeks, 1,050 dozen handkerchiefs, at 8 s. per dozen, ...	420	0	0
216	persons employed. Cost of labor, . .	£2,209	6	8
	Cost of flax, . . .	75	0	0
	Profit, ...	340	13	4
	Value of 1,050 dozen handkerchiefs, at £2 10 s. per dozen, ...	£2,625	0	0

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VIII. — LIVE STOCK.

I come now to speak of one of the most important topics connected with British agricultural improvement — the live stock of the country. Among the conflicting opinions and estimates which prevail, both in this country and the United States, in respect to different breeds, my judgment may be viewed with jealousy and suspicion, and I may have to encounter fierce prejudices, on the part of breeders and speculators. My opinion will be given without any pecuniary bias whatever; and I beg my friends will, in any event, regard it as that of an humble individual, making no pretensions to infallibility of judgment, and anxious only to give the result of his various inquiries and observations, in as impartial and simple a form as possible.

Two things impress strongly the mind of an observing traveller, in this matter; — the first, the variety of distinct breeds which present themselves; and second, the perfection to which individuals, and large numbers of each of these breeds, are carried. Different localities in the kingdom have their favorite breeds, are tenacious of their peculiar merits, and are sure to prefer them above all others; and, at the same time, the pains and expense, which are bestowed upon their improvement, have been rewarded by many examples, in most of the breeds, of what may be called the perfection of form, and the highest degree of fatness — a degree of fatness transcending the most stimulated appetites of epicurism, and verging, in some cases, almost to disgust.

The science, or, perhaps, it may be called the *art* of breeding, has been greatly studied. But notwithstanding the success which has attended it, especially with some men, yet, as in respect to most recondite subjects in nature to which the human mind has applied itself, there remains a great deal to be understood and explained; and we, as yet, have only passed the first steps on the threshold. The evidence of this is found in the fact, that the great question of the propriety of breeding in and in, or of propagating within certain lines of affinity, is still a mooted question. High authorities are quoted on both sides. Indeed, it must be obvious, that unless we suppose several distinct individuals of the same race, wholly independent of each other, to have existed at the same time, and to have been the foundation of so many distinct families, there must exist, among the animals of the same race, an inextinguishable relation of affinity by blood. The whole object of the famous Herd Book is, indeed, to trace back all these diverging streams to a single fountain, and thus, by an uninterrupted descent, to demonstrate the purity of the blood. But our ignorance, and the consequent limitation of human power, are evinced by other facts. Although there are frequent approaches to excellence, yet no human sagacity can command results. Animals of the same family often differ essentially among themselves. Pigs of the same litter seldom fail to present a variety; and twin animals are frequently marked by peculiar and striking distinctions from each other. The famous bull Comet is still considered as the unrivalled paragon of excellence; the celebrated Durham ox remains without a successful competitor; and the brothers and sisters of the well-known Charlemont ox, shown in various parts of the United States, and afterwards received in England as an animal of most extraordinary size and fatness, were none of them remarkable for any peculiar excellence. This was strongly evinced at a recent letting of rams, or *tups*, as they are here designated, which I attended, at the residence of one of the best farmers, and one of the most eminent breeders of Southdown sheep, in the kingdom, Mr. Jonas Webb, of Babraham, in Cambridgeshire. Here were exhibited one hundred and seventy-seven animals of the finest description, bred with all the care which it seems possible to exercise, and with all the skill which great acuteness of judgment and long experience could give. Yet the differences among these animals, in form, symmetry, size, quantity and quality of wool, were so great, that while the services of some of them, for a season, were rated at five guineas, those of others readily commanded fifty guineas.

But although human sagacity and power can command no more, it should be matter of grateful surprise that so much is within their reach. The great law that like produces like, though it may not be invariable, is, comparatively, of universal operation. Good qualities are propagated by the union of animals possessing good qualities; and defects, and faults, and infirmities, are, in like manner, extended and aggravated. The application of this principle, or physical law, has, in this country, been most marked in its results. From all that I have seen, there seems to me reason to doubt the power of any man to produce what may be called an entirely new breed, or to do any thing more than, by his skill, to modify or improve such as already exist. This, however, is often done in a most remarkable manner. The old proverb certainly holds true, that "a good cow may have a bad calf;" but then it is much more likely that she will have a good one, than that a bad cow will have a good calf. The confidence with which some persons speak of what can be done, and what they can do, is often excessive; but what has been accomplished by selection, by crossing, and by the conjunction of peculiar properties, is surprising. There seems a limit, beyond which, perhaps, no person can go. The particular breed may be altered and improved, but an entirely new breed cannot be produced; and, in every departure from the original, there is a constant tendency to revert back to it. The stock of the improved Durham cattle seems to establish this point. If we have the true history of it, it is the result of a cross of a Teeswater bull with a Galloway cow. The Teeswater or Yorkshire stock are a large and coarse-boned animal; the object of this cross was to get a smaller bone and greater compactness. By attempting to carry this improvement, if I may so say, still further, by breeding continually in and in, — that is, with the members of the same family, in a close degree of affinity, — the power of continuing the species seems to become extinct; at least, it approximates to such a result; the race becomes deteriorated. On the other hand, by wholly neglecting all selection, and without an occasional good cross with an animal of some foreign blood, there appears a tendency to go back to the large-boned, long-legged animal, from which the improvement began. One point seems admitted, that, since the days of Mr. C. Colling, the great founder of what is called the *improved short horns*, though the race has become diffused to an extraordinary extent, and multitudes of fine animals are now produced where then there were few, yet no higher excellence has been reached than that to which he attained. The greatest stress is every where laid upon purity of blood; and yet it is rather an anomalous fact, in this case, that Mr. Colling's famous stock was the result of a cross between a Teeswater bull and a Galloway cow; that some of the best animals in the country, for size, and fatness, and milk, have been the progeny of a first cross with a different breed; and that an extreme limitation, in breeding, to the same family has been almost invariably followed by the deterioration of the stock. "There are several instances of superior animals bred in the closest affinity; whilst, in a very great majority of cases, the failure has been excessive and lamentable. It was notorious that the stock got by Comet out of cows that were strangers in blood, were far superior to those from cows more nearly akin. Mr. Mason, of Chilton, commenced breeding short horns from the same parents as Mr. C. Colling, and, for a certain period, pursued it very successfully; but, being deprived of the privilege of sending his cows to the Ketton (Durham) bulls, he was constrained to use those of his own breeding; and the losses he sustained, in his young stock, were so great that, at one time, his show cows were reduced to four; but by using the bull Jupiter, whose affinity of blood was supposed to be remote, he again became a successful breeder."* It would be contrary to all observation and experience, to deny the exclusive merits of different breeds, and the tendency of all animals to propagate their like; but it would be equally so, to deny that extreme results often contradict our expectations, and that both science and observation are, occasionally, at a loss to determine the influences by which these irregularities are brought about, or by what means they may be controlled.

In treating of the live stock of Great Britain, it is obvious, that my remarks must be brief and desultory, upon a subject on which many volumes have been, and still may be, written.

1. Horses. — Among the most improved animals in the kingdom, horses take a prominent place; and a circumstance of difference, in this matter, between England and the United States, which strikes one at first sight, may be called the division of labor among the horses. The American horse, in most of the states, is, generally, a horse of all work. Here, the horses are bred and trained for, and exclusively confined to, particular departments — sporting, pleasure, travelling, draught or agricultural labor; and nothing is more rare, than the transfer of the animal from one department to the other. So we find the race-horse, the hunter, the carriage-horse, the draught-horse, the roadster, the saddle-horse, the pony for children and ladies, the general hack, and the farm-horse. This comes of the immense wealth of the people, and is adapted to give them the best advantages of each kind. It may surprise some of my friends, to tell them, that I have more than once found forty hunting horses in one

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* On Short Horn Cattle, by I. Wright. Journal of Royal Agricultural Society, vol. vii. p. 1.

gentleman's stable, for himself and his huntsmen; and in one instance, I found a stud of eighty horses, of different kinds, exclusive of the farm-horses. The perfection to which these animals have been brought, the condition in which they are kept, the tenderness, and kindness, and care, with which they are treated, and the admirable manner in which they are groomed, are circumstances, here, all over the country, in the highest degree worthy of remark. I have already referred to them. Their hours of rest, of feeding, and labor, are observed with strictness; their stables are spacious, lofty, well-ventilated, and adapted to preserve, as far as may be, an equable temperature; they are carefully bedded, and cleanly littered, and whatever would be offensive, at once removed; they are thoroughly curried, and brushed, and a horse brought into the stable, in a state of perspiration, is never left until he is completely dried by rubbing; nor, in any case, have I seen a horse left to stand still, exposed to a cold draught of air. The treatment of them is most exemplary and creditable; and is no more than just to animals, incapable of taking care of themselves, to whom we are indebted for so much of pleasure, and so much of profit. At the house of an eminent nobleman, whose hospitality I enjoyed, it was the invariable custom of the family, — ladies and guests, as well as the master, — about nine o'clock in the evening, to go, by a covered passage, into the stables, where thirty horses were kept, to see that the grooms and ostlers were at their post, that the horses were well, and cared for, and the stable in good order. Nothing could exceed the cleanliness and order in which every thing appeared. At one of the principal breweries in London, where forty of the largest size dray-horses are kept, the manager informed me that, after six years hard service, the horses receive their freedom, are sent into the country, exempted from all labor, and kindly cared for during the rest of their lives. I confess, in observing these kind provisions, and this extraordinary care, I have not been able to suppress the wish, that many of the bipeds, who share with these animals in the labor of the field, — not unfrequently performing the hardest part of it, — could experience, in their own persons, an equal care, and find in their cottages, on their return from a hard day's work, even a moiety of the comforts with which the stables of their co-laborers are provided. It would be doing great injustice, to say that this is not often done by many persons, who have no greater pleasure than in providing for the comfort and welfare of their dependants. It is only to be regretted that the practice is not universal.*

In the breweries in London, and in the drays in the cities, horses of an enormous size are employed ; and the same kind of horses are employed on many of the farms. The weight of one of them, ascertained in my presence, exceeded seventeen hundred pounds ; and he was by no means extraordinary for size. I do not desire to see such horses introduced among the farmers of the United States. Their motion is slow and clumsy, and their keep expensive. In cities, where the vehicles are heavy, and the burdens of coal, and beer, and other goods, very great, they are well suited to the service for which they are used. As far as proportion, color, and action, are concerned, they are, certainly, magnificent animals. With many farmers, these horses are raised, not as being preferred for farm labor, but for sale in the cities ; and, after being broken to service on the farm, are, at a proper age, sent to market.

But the horse best adapted to agricultural purposes is of a smaller size, a compact form, short, strong, and muscular limbs, full-breasted, and with round buttocks, of which a favorable representation may be found in the plate accompanying my first report. There are three breeds of horses in the kingdom, distinguished for their valuable properties as farm-horses ;— these are the Cleveland Bay, a horse of great strength, and good size and figure ; the Suffolk Punch, a large and serviceable horse ; and especially the Clydesdale horse, almost exclusively preferred among the excellent farmers of Scotland, particularly in the Lothians. I have seen nothing superior, in my humble judgment, to the last horse, for farm labor, combining good size, with compactness, strength, and action. In Ayrshire, the farmers, being of an opinion that their fine breed of horses was deteriorating, recently imported a stallion from Flanders. This horse was a model of compactness, and strength. He was fifteen and a half hands high; his girth, behind his shoulders, was seven feet, four inches, and seventy-five inches round his neck, at the base; he was twelve years old, and cost sixty guineas, in Flanders.

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* No person can have passed through the highly-improved territory of the Duke of Buccleuch, in Dumfriesshire, which the public road traverses for more than twenty miles, and observed the clean and comfortable cottages of the laborers, which constantly meet the eye ; nor have seen the almost luxurious provision made by the Duke of Devonshire for his dependants, in his picturesque village of Edensor ; nor the humane provision made by the late Lord Leicester for his aged and decayed laborers, at Holkham ; nor have witnessed the extraordinary and beneficent exertions of Lady Noel Byron, by allotments, loan, and benefit societies, and industrial schools, for the comfort, instruction, and improvement of her dependants, and the poor ; nor the beneficent and parental conduct of many, *many* others, to whom the strong and unaffected attachment of their laborers and dependants evinces the deepest sense of kindness, but whose names it might seem invidious to mention, — without a grateful acknowledgment of the goodness of Heaven, in making minds so just and generous the almoners of its bounty.

The farm-horses, in ploughing, are never worked more than eight hours a day. The ploughman feeds and cleans them at four o'clock in the morning. They are harnessed, and the plough started, at six o'clock. They are brought to the stable again at two o'clock, and fed, and thoroughly groomed, curried, cleaned, bedded, &c., and left for the night, at dark. The feed is almost always cut for them, or if given long, given in small quantities; and the oats and beans are crushed. On one farm, the allowance for a farm-horse of the largest size was, two bushels of oats, and one peck of beans, and two trusses of hay, (fifty-six pounds each,) per week, in winter; in summer, green feed, vetches, clover, or rye grass, was substituted for the hay. The general allowance is a peck of grain, half oats and half beans, and from fourteen to sixteen pounds of hay, per day. The army allowance for a horse is fourteen pounds of hay, ten pounds of oats, and seven pounds of straw, per day; "with hard work, less hay, and more corn; with little work, less corn and more hay." The horses belonging to the Queen's Guards, which are often to be seen in the streets of London, and always on state occasions, are beautiful animals, and subjects of universal admiration. They are of a black color, and bred, I believe, on the continent, purposely for the army.

The general rule is, to keep, on arable farms, a pair of horses for every forty acres; in some cases, the proportion of land to the team is larger. One of the best farmers in Scotland allows seven horses for two hundred acres. His land is accessible, and extremely favorable for all farming operations. The cost of keeping a working horse (exclusive of interest or deterioration) he estimates at twenty-five pounds, or more than one hundred and twenty dollars, per year. These expenses all have reference to the local prices of agricultural produce; and I give them rather as matters of curiosity, than of direct utility to my American readers. The amount of ploughing for a day's work is an acre of land, but, in some cases, an acre and a half. One farmer speaks of ploughing, usually, seven acres in a week, with one pair of horses. The furrow slice varies from eight to eleven inches, and the distance travelled, in such case, is from twelve to sixteen miles a day. It does not lie within my province to speak of other horses than those employed in agricultural labor.

Oxen are employed for farm labor to a small extent, and in few counties. On Lord Leicester's farm, at Holkham, so much and so long celebrated, they are used and worked in leather harnesses; and in some places, I have seen them worked singly in harness. The general impression is, that they will not do so much work as horses, are not so easily trained, and are more expensive to keep; every one of which positions is, in my opinion and experience, erroneous. I believe these opinions arise out of an entire ignorance of the training of oxen. Nothing can be more awkward than the management of them, which I have seen here. As they are managed and trained in the best parts of New England, their docility is perfect; working without a driver, in the ploughfield, as well as with one; performing as much work as a pair of horses, and performing it as well; costing comparatively nothing for harness, since a wooden yoke and bows, and iron chains, which will last for years, are all that are required; when well cared for until six years old, paying, by their growth, for the feed which they consume; and, when kept in good condition, as they always should be, if ruined for work by any injury, or if at an age to be turned off for beef, exposing their owner to no loss. In every thing but road work, I am quite satisfied that a pair of well-trained oxen will perform as much work as a pair of horses, and at a much less expense. This was the opinion of an English ploughman, who lived some time in my service, and worked wholly with oxen. He had, before this, been used to horses, and a more skilful ploughman I have never seen on either side of the water. The use of oxen has become much less common than before the introduction of the improved breeds of cattle, which are now brought so early to maturity. Formerly, it was not the custom to send oxen to market, before five years old; now the Durham stock, and others, go at eighteen months to three years old. Under this arrangement, there is no opportunity to get any work out of them.

The Scotch plough with two horses abreast, and seldom use more than two. In many parts of England, horses are worked *tandem;* and I have sometimes seen five and six, at length, to a single plough. This is certainly excessive, and the turnings, in such case, most inconvenient; but the motive for putting the horses at length is, that, where the land is heavy, it may not be trodden hard.

2. NEAT CATTLE. — There are several distinct breeds in Great Britain, of which I shall not undertake to give a description in full. Such descriptions already fill volumes. The principal breeds which have fallen under my notice are the improved short horns, the Hereford, the North and South Devon, the Staffordshire long horns, the Ayrshire, the polled Aberdeenshire or Galloway, the Kyloes, or West Highlanders, and the Kerry. There are other breeds, and animals of every cross, variety, and mixture. It would seem that nothing can exceed the perfection to which many of the individuals of each of these breeds are brought. At the Christmas show of the Smithfield Club, they appear in elephantine proportions, like so many moving masses of fat. As I have already observed, the different breeds have their exclusive partisans. That excellent friend of agriculture, the late Lord Spencer, was the great patron of the improved short horns; yet he kept the Alderney to supply butter, and the West Highlanders to furnish meat, for his own table. The late Lord Leicester, so many years at the head of the English farmers, preferred the North Devon. The Duke of Bedford, eminent for his agricultural improvements, and for, perhaps, one of the most complete agricultural establishments in the world, prefers the Herefords; and so with Mr. John Hudson, of Castle Acre, in Norfolk, whose agricultural authority is of the highest character. The farmers who are fatteners of stock are always anxious to purchase the Scots or West Highland cattle, as being always sure of a market and of returning a fair profit.

(1.) *The Improved Short Horns.* — The improved short horns are a singularly beautiful breed of animals, and, it will be admitted, are the most popular breed in Great Britain. In perfection, they are of large weight, fine-boned, come to maturity early, exhibit great proof upon being killed, and although they are admitted to be great consumers, and require very high feeding, they are considered a very profitable stock for the farmer. They are, it is said, originally of the Teeswater breed, imported from Holland, but greatly improved by selection and crossing. That an individual, in his lifetime, should effect such improvements, as all admit Mr. Colling, the reputed founder of the breed, did, and derive immense profits from his enterprise, is a fact full of encouragement. They are commonly brought to market before three years old, and often at eighteen months. The calves often run with the cow six months, and are frequently fed with artificial food from the time they can be made to take it until they are sent to the butcher. The best of these animals, however, have a strong natural tendency to keep fat; but they are not suited to a short pasture, or a scanty manger. It is not invariable, that animals consume in proportion to their size; but it can hardly be questioned, that there is ordinarily some relation between the size and the proportion of food required. It will, I think, not be denied that they are great consumers. An intelligent herdsman, who had been accustomed to the feeding of fattening animals for eighteen years, and, with respect to whose judgment, I know of no private interest to affect it, gave it to me, as his decided experience, that the short horns require a third more food than the Herefords. This judgment must go for what it is worth.

The high-bred animals are not remarkable for their milking properties. There are exceptions, but most of these animals are inferior in the quantity and quality of the milk; though there can be no doubt that both quantity and quality will be affected by the kind of feed supplied them. Individuals of rare excellence, in this respect, may be selected from among them; but the extraordinary accounts which are sometimes given of whole herds or families, must be received with a degree of distrust. The finest herd of short horns which met my observation — though it must be remembered that, if I have seen many, they are but few compared with the whole number to be seen — I found in Lincolnshire, in the possession of one of the best farmers in England, a tenant of Lord Yarborough. They were not in the Herd Book, but had been in possession of the family more than fifty years. A superior lot of cows, in appearance and condition, I never saw, nor expect to see; but they were not distinguished for their milking properties. The property to take on fat is considered inconsistent with that of large secretions of milk. This is not without exceptions within my own knowledge, but is generally true. I shall recur again to the milking properties of the short horns. The beef of the short horns, though good, is not considered of the highest quality. This may be partly ascribed to the early age at which they are killed. It is believed, however, that few animals, under proper management, pay better for the care bestowed upon them; and although the prices of the present day are small compared with what they were at one time, this may be traced to various causes, not implying a lessening of public esteem for the breed. The breed, for instance, is greatly extended, and good animals are not difficult to be procured. The prices formerly given were much too high, owing to the small number of animals to be had, and the much higher comparative prices of all agricultural products, at that time. For labor, as far as my observation goes, they are not used at all.

(2.) *Herefords.* — The great competing breed with the short horns are the Herefords, which, excepting in Herefordshire and the neighborhood, are not so widely spread as the short horns. It would be difficult to adjust the rival claims between these two great breeds. The Hereford cattle are exceedingly neat in their limbs and form, and of good size. At the show of the Smithfield Club, held at Christmas, the highest prices appear to alternate between the short horns and the Herefords. Under proper treatment, they may be brought to as early maturity as the short horns. I think I have never seen so fat animals as some Herefords; but the fat is not so evenly diffused as in the short horns, and seems laid on in large lumps and patches, which is an objectionable circumstance. They are not so great consumers as the short horns, and their thrift is remarkable. Some farmers in

England prefer them, as fatting beasts, to the short horns.* This may be mere prejudice, — for what class of men, and, in respect to many subjects, what men are free from prejudices? My observation inclines me to the belief, that, in equal numbers, there are as many good Herefords as short horns; and the thriftiness of many of them is quite remarkable. A large proportion of the short horns stand too high, and have too long legs. The Herefords are not exempt from this fault, but have less of it; but they lack substance and breadth behind. In respect to handling, observing persons know that, in this matter, there is every diversity among animals of the same breed, and that it is rather the characteristic of individuals than of a tribe; but I may hazard the general remark, that, as a breed, few animals handle better than the Hereford. I heard from some individuals very much in favor of their milking qualities, but from these persons, though a long time owners of the stock, I could get no authenticated statements. The answer to my inquiries always was, that they kept no exact accounts, but knew their cows were excellent milkers, and gave a very large yield. The habit of praising our cows is, in most cases, very much like men's habits of thought in regard to their children. In this matter, the geese of most men are swans. In general, the Herefords rank low as dairy animals, and are considered inferior. This is the general impression; — as such I give it. Public opinion is not always well founded, and I shall leave to others to determine, in this case, what value to attach to it.

(3.) *The Devons.* — The Devons, taking their name from the beautiful county of Devonshire, where they are principally found, are of two kinds, the North and the South Devons. The North Devons are a comparatively small race of animals, with long and beautifully-turned horns, of a deep red color, short-legged, and compactly built, exhibiting, to my eye, the perfection of form and symmetry, with soft, silky coats, and with hair in curled and waving lines, in appearance like the most beautiful varied mahogany that ever came from under the plane of the cabinet-maker. They do not attain a large size, but they are so compact, that they weigh heavily for their size, and there is no waste in them. The South Devons are animals of a much larger frame, often coarse-boned, attaining sometimes to a considerable size, not remarkable for thrift, coming late to maturity, and, in truth, identical with the great mass of cattle to be found in New England. It is but just to say, in respect to the South Devons, that, as far as I could learn, no particular pains have been taken to improve their breed, and to see what could be made of them, as in the case of the short horns, the Herefords, and the North Devons.

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* Upon reading the above, a very intelligent and experienced salesman informs me that, although the very best Herefords command as good prices as formerly, yet the ordinary Herefords which come to market are very hard of sale, and are the least esteemed beasts which appear at Smithfield. This he considers attributable to some mistake in their breeding, or to breeding too long in near affinity.

The North Devons are, as a breed, most highly and deservedly esteemed. They have the preference of all other breeds for the yoke, being strong, active, and of great endurance; add to this, a remarkable docility, and good temper. It is generally thought that they do not arrive at maturity as early as the short horns or the Herefords; — I do not know that the same pains have been taken to force their progress. An eminent breeder of North Devons contradicts this. He is one of the most experienced farmers in Great Britain; he has been long accustomed to rear them, and insists that more money can be made from them than from any other breed. Of course, this opinion would not meet universal assent, and would be rejected by the advocates of some of the other breeds; but the long experience of this farmer, and his admirable and successful husbandry in every department, entitle his opinions to great consideration; and my confidence in him is such, that, in parliamentary language, in a division of the house, I should be strongly inclined to go into the same lobby with him. They are highly esteemed in Smithfield market for the excellence of their meat, and because its size is more agreeable, on most tables, than the huge joints of some other breeds. In weight, they are much excelled; but the opinion of their advocates is, that more meat can be made from them with the same amount of feed. Of their dairy properties I shall speak presently.*

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* A fine example is given of this stock, in the frontispiece to my Fourth Report, vol. i. p. 285.

(4.) *The Ayrshire.* — The Ayrshire stock prevails, principally, in Ayrshire, Scotland, and is certainly a beautiful race of animals. It is maintained by some that they are of the same breed, with some slight variations, as the improved Durham short horns. However they may approximate each other in crossing, as races, I believe them to be as distinct as the short horns and the Devons, and a practised eye will easily discern the difference. They are considerably smaller than the short horns; much lower on the leg; with larger bodies in proportion to their size; not of such length as the short horns; in general, with finer limbs; their faces not quite so long, nor so tapering. Their color somewhat resembles that of the short horns, though there is less of white, and the white not so snowy and clear, and none of the roan color, which often makes the Durhams extremely beautiful. They are occasionally spotted with white, as if large flakes of snow, or feathers, had been scattered over them. They are of good thrift, but do not constantly show the same good condition as the best short horns, especially when in milk. When dry, however, they fatten well; and no animals can be more prized than they, in the highly improved and picturesque county of Ayr, where they are principally found. They are chiefly valued for the dairy, and are considered by many persons as, in this respect, excelling all others, — a conclusion to which I demur, for reasons which I shall presently give. I am not about to depreciate them, for a fine Ayrshire cow, with her full udder, is greatly to be admired for her beauty and her product. It is said that they always do much better in their own locality than when they are removed, for example, into England. I know other animals who do not thrive so well from home as at home. It is said of the Scotch themselves, such is their native acuteness and enterprise, that they will thrive in whatever country they may be thrown. This does not appear to apply to their cows. There may, however, be another reason. I recollect a man's having purchased a cow, represented as remarkable for her extraordinary yield of milk, from one of the richest pastures that could be found; and upon taking her home to shorter commons, he complained to the former owner that he had imposed on him. "Sir," said he, in reply, "I sold you my cow, but I did not sell you my pasture."

The Ayrshire cows are extremely thrifty when dry. When fatted, the four quarters weigh from twenty to thirty tron stone, of twenty-four pounds each, that is, from four hundred and eighty to seven hundred and twenty pounds. An Ayrshire farmer informed me that he had had cows weigh fifty-one stone, or one thousand two hundred and twenty-four pounds, each. He says, there are no better feeders, and that, when fatted, the beef is as good as that of the West Highland cattle.

(5.) *The West Highland Cattle, or Kyloes.* — This is a small breed of black cattle, bred in the remote Highlands, and on the northern islands of Great Britain, and brought in immense numbers to the south to be fed. They are short, hardy, thickset, always in good condition, and exceedingly thrifty, when brought from the short feed of the north into the rich pastures and to the abundant mangers of the south. Their size is small, but their weight very great in proportion, as they are extremely compact and solid. Their meat is esteemed of the best quality in the market, and commands, usually, a halfpenny a pound more than any other. They are bought in, at times, quite young, and kept until three years old, when they are sent to market. They are thought, when well purchased, to pay a better profit than any other; and on this account, as well as their symmetrical shape, — for, taking off the head, and neck, and the legs, they would appear to form a perfect parallelogram, — they are universal favorites.* No advantage has come, in any way, from crossing these cattle with any other breed. There is a small kind of black cattle, without doubt allied to the West Highlanders, which are brought to Smithfield market, and there vulgarly known as *runts.* They cannot properly be called a distinct breed. They are extremely compact and heavy, and their meat excellent. No beef animals in the market sell so well.

(6.) *The Aberdeenshire Polled Cattle,* near relatives of the Galloway and the Angus cattle, if my memory serves me as to the name, are likewise black in color, and admirable in appearance. They, also, are deemed highly profitable stock both for thrift and for the dairy; and a herd of cows, I believe of the latter breed, horned, entirely black, excepting their udders, exhibiting the strongest indications of being most abundant milkers, shown at the cattle show at Dundee, have, in my view, rarely been surpassed. Of the Aberdeenshire cattle, a picture of a superior specimen is given, vol. i. p. 385.

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* A just representation of one may be found at the beginning of my Third Report, vol. i. p. 189.

(7.) *The Alderney or Guernsey Cattle.* — Of all the cows which I ever saw, the handsomest, — that which gave my eye the most pleasure, that which gave the best promise of being what a cow should be, — was an Alderney, or rather, improved Guernsey cow, brought from one of the Channel Islands, and shown at the meeting of the Royal Agricultural Society, at Southampton. She was rising two years old, of moderate size, compact, and well-shaped, of that yellowish dun color which generally characterizes the breed, with a large and golden udder, ears of an orange color in the inside, a clean and thin neck, and the bright eye of a gazelle. This showed to what perfection the breed might be brought; for, in general, they are exceedingly ugly, small, thin, coarse-boned, and presenting little more than the skeletons of animals, covered with a yellowish, flabby, and coarse hide. They come principally from the Channel Islands, Jersey and Guernsey, and abound in parts of Hampshire, and counties most accessible to these islands. They are valued mostly for their milking properties, and not so much, in that respect, for the quantity, as for the extraordinarily rich and creamy quality of their milk, in which certainly they surpass all other breeds. It is stated that no animals will thrive faster, when well-fed and not in milk; and their size is not always inferior. I found at Welbeck, the residence of the Duke of Portland, a herd of Alderney cows, of the size of ordinary cows, and in good condition.* Few gentlemen or noblemen in England, resident in the country, are without one or more Alderney cows, for the supply of their tables with cream and butter; and I never have had the slightest difficulty in instantly recognizing their produce. They are kept, in some proportion, at some of the large farm dairies in England, for the purpose, by mixing their milk with that of other cows of a different breed, of giving color to the butter, and richness to the cheese; but I was informed, at one of the best dairy farms in Gloucestershire, where forty cows are kept, that a dairy exclusively of Alderney cows "would not make good cheese, or rather would make it too rich;" and that, beyond a certain proportion, and that not a large one, it was not advisable to mix their milk with that of other cows. So difficult, however, is it to determine any thing, that I have found other farmers to state that they have succeeded perfectly in making excellent cheese from the milk of the Jersey cows.

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* Two Alderney oxen, fatted by that distinguished and liberal friend to agricultural improvement, Sir Charles Morgan, of Tredegar, Wales, weighed alive, the one, one thousand six hundred and ninety pounds, the other one thousand six hundred and fifty pounds.

This excellent man, now verging towards ninety years old, but retaining in his mind all the elasticity and cheerfulness of youth, has an annual agricultural show on his own estate, free to competition, and, since its institution, has himself given more than five thousand pounds, or twenty-five thousand dollars, in premiums. I have had the pleasure of attending two of these shows, and witnessing the grateful enthusiasm with which this agricultural patriarch is received among his attached neighbors and friends.

The improvement which has taken place in this breed, in the Island of Jersey, a specimen of which I have given an account of above, is most remarkable; and in their improved condition, for certain purposes, especially for the luxury of cream and butter, it would, I think, be impossible to find a more valuable breed. It is objected to their beef, that the fat of it is too deeply yellow, but otherwise it is deemed excellent in quality.

(8.) *Dairy or Milking Stock.* — The milking or dairy properties of the different breeds have been matter of much discussion; and it would be difficult to find a unanimous, perhaps not a general acquiescence in any opinion. This should be an argument for forbearance on the part of those persons to whom my judgment might appear erroneous. Mr. Bates, one of the most distinguished breeders of short horns in the kingdom, and a successful prize winner for his stock, gave me as his opinion that there were two lines of the short horns — the one large milkers, the other different. No such marked or sectional distinction has come within my observation; but individuals of remarkable productiveness in this respect are constantly to be met with. Few things in this world are without exceptions; but as a general rule, other circumstances being equal, the yield of milk will be in proportion to the size of the animal. The cub of an elephant requires more milk than a calf or lamb, and doubtless there is more provided for him.

The high-bred Durhams are generally poor milkers. They do not give large quantities; the milk is not rich in butter properties. Now I shall contradict this by some examples, but they, I believe, are the exceptions, and not the rule. A Durham or short-horn cow, owned in Cambridgeshire, made sixteen pounds of butter one week, and at the rate of fourteen for a considerable length of time. I have found several that made twelve pounds and fourteen pounds of butter, a week. These, however, are rare instances. Mr. Bates informed me, that one of Mr. Collins's cows gave at one milking, at night, twenty-six and a half quarts; another gave twenty-four quarts of milk per day; another, nineteen quarts. I did not understand him to make these statements of his own knowledge. His own celebrated cow Duchess gave fourteen quarts at a milking. These are all animals of high blood; but it is the general experience of the keepers of such animals, that their qualities for milk are inferior. Mr. Bates informed me, these were beer quarts. Wine to beer measure is as about four to five.

The Yorkshire or Teeswater cows, from which the improved Durham are derived, are large milkers. It is an evidence of this, that most of the cows kept in the London milk establishments are the Yorkshire. They are, in general, very large animals, and their size for fattening, when their milking is over, strongly recommends them. In condition, they are variable, a cow giving large quantities of milk seldom showing high condition; though even this is not without exceptions. It is rare, however, in any case, to find them in low condition. At a large milk establishment in Edinburgh, kept by a woman, she told me that she had owned a Teeswater or Yorkshire cow, which had given twenty-two Scotch pints, or forty-four quarts, of milk, per day. I was assured of this woman's credibility; but then, with a perfect respect for the conscientiousness and good intentions of the sex, I habitually distrust their arithmetical accuracy, whether in regard to their own age, if they are far on the journey of life, or to other matters. It is not in their way to remember numbers exactly. The great astronomer, Mrs. Somerville, is a rare and magnificent exception.

At a London milk establishment which I have repeatedly visited, the yield in milk is chalked upon a board, over the head of each cow. Most of them are of the Yorkshire breed. I observed, in my last visit, one yielding twelve quarts per day, one sixteen quarts, and one, an Ayrshire, twenty quarts. One cow was shown to me, a Yorkshire, which had yielded twenty-three quarts per day. These were wine quarts, as I understood. Their feed, at this time, was half a bushel ale grains, each, per day; twenty-eight pounds of hay; some potatoes, and newly mown grass, the quantity not determined. Ale grains, it is said, will make more milk than porter grains. This is the opinion of practical men.

At another milk establishment which I have repeatedly visited, two hundred and fifty cows are kept. Here, both Durham and Yorkshire are principally kept. They are preferred, as being best for milk, but especially as fattening easily, when dry. The average yield was stated at eight quarts per day to a cow, through the year, and, before "the disease" prevailed among them, at ten quarts. This is certainly a large amount. The cows are never turned out; water is given to them in their troughs. They appeared in very good condition, — certainly much better than the men who attended upon them. They were kept in milk as long as they would pay, though one of them had been in milk three years, and then gave only three quarts per day. They stand upon brick floors. Their feed was one bushel of grains in the morning, and one in the evening, with ten pounds of potatoes, and twenty pounds of mangel-wurzel to each cow, per day. One truss (fifty-six pounds) of hay was divided among ten in the morning, and one truss among twenty in the evening. In the proper season, grass — clover or rye grass — is supplied, but the quantity not determined. In some cases, one bushel and a half of grains, forty pounds of mangel-wurzel, and ten or twelve pounds of clover hay, constituted the allowance of each cow. This must be considered as very liberal; and what better repays such liberality than a good cow?*

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* I may observe, in passing, that two strippers were employed at this establishment to follow the milkers; and that a fine of a shilling was always levied upon the milker, when any milk was found after he or she had left the cow. The milk is sent out in sealed or locked vessels, containing eight gallons each, which are carried upon men's or women's shoulders, and distributed over the town. Where the vessels are locked, the milk cannot be adulterated after it goes into the hands of the distributors. What perils it passes through before that time, those who use it can best judge. The labor of distributing seems severe upon women, who are much employed for this purpose, and who are principally from Wales; but, in general, they are examples of ruddy health and great muscular

In St. James's Park, where several very large cows — Yorkshire — are kept tied constantly through the day, for the purpose of supplying a glass of milk fresh from the spring, for those whose unadulterated taste can relish it, and where the cows are petted and highly fed, I have occasionally inquired for the yield. The answer, from an intelligent and civil keeper, has been, sixteen quarts per day, and, within his knowledge, never more.

The first cross of the improved Durham stock with the Ayrshire or the Devon has, I may say, almost invariably, produced a fine milking animal. This point may be deemed established. Innumerable instances of this have come under my own observation. I found one instance, in Leicestershire, of a cross between a Durham and an Alderney. The cow, the progeny of such cross, produced sixteen pounds of butter per week, for ten successive weeks, upon grass only. This farmer had twenty-two cows, nearly all of them high-bred Durham stock; but he candidly stated that they were not good milkers.

The Ayrshire stock are generally deemed the best milking or dairy stock in the kingdom. This is a strong statement; my own observations, which were, however, of necessity limited, would make me hesitate in speaking so emphatically. Their general reputation is, certainly, strongly in their favor.

The excellent farmers of Ayrshire — and it would be difficult in any part of the kingdom to find their superiors — are most emphatical in their preference of their own cows for the dairy. Some of the large farmers, under what is called the *bowing* or *boyening** system, let them to smaller farmers, who pay the owner ten pounds a year for the cow. The owner provides for the cow, and incurs all risks of injury or death. The lessee takes the entire care and management of the cow, and generally gets for his profit two pounds to three pounds per cow. This speaks favorably for the stock, though, to ascertain the exact result, the market value of the produce, and the price of dairy labor, and other circumstances, should be known.

I visited, in Ayrshire, a principal dairy farmer, of high reputation. His cows are all of the pure Ayrshire; he will have

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power. In several parts of London, one is entertained, twice a day, with the cry of "Milk from the cow!" which is the signal that the cow is passing your door, and, if so you please, you may draw the precious beverage from the fountain.

* *Boyen* means milk-pail.

no other. They were extremely beautiful animals. His best cows, in the best of the season, gave fifty-four pounds of milk per day. If, as is usually reckoned, a pint is a pound, this would be twenty-seven quarts per day. The average yield was forty pounds per day, or twenty quarts. Yet the amount of butter yielded by them was one pound per day, it requiring forty pounds of milk to produce one pound of butter. They were at grass, and had no extra feed. This was a large proportion of milk for the butter. This farmer was then (September 26th) milking thirty-five cows, from which he sold, the previous week, one hundred and fifty pounds of butter, — not a large amount. It is stated, confidently, upon authority which I personally know is entitled to entire confidence, that an Ayrshire cow has given eighteen Scotch pints, or nearly thirty-six English quarts, per day; and that a three-year-old heifer gave, for six weeks after calving, fourteen pints, or twenty-eight quarts, per day. These were extraordinary animals.

The account given by a celebrated writer on dairy husbandry, that "there are thousands of the best Ayrshire cows, which, in their best condition and well fed, will yield four thousand quarts of milk per year, and produce three hundred and seventy-five pounds of butter each, — and that, in a dairy of sixty cows, every one yielded her own weight, annually, of the best cheese to be met with in Scotland," — must, I think, have been penned some evening when the northern lights, the aurora borealis, were peculiarly brilliant in a Scottish sky. I do not deny the truth of these statements; but my own observation has not confirmed them.

The statement of a farmer in Stirlingshire, of the highest eminence, given to me, was, that his Ayrshire cows, in the best of the season, averaged one pound of butter per day; that he has known two Ayrshire cows to make two pounds two ounces each per day; and that with him sixteen quarts of milk produced one pound of butter.

The North Devon stock have some strong advocates as a milking stock. The most productive cow in butter which I have found was a North Devon, which, for several weeks in succession, without extra feed, produced twenty-one pounds of butter per week. The character of the owner places the fact beyond a doubt. Mr. Bloomfield, the eminent tenant of Lord Leicester, after many years experience, states that his North Devon cows will give an average of four pounds of butter per week, through the year. One English pint of milk, as he adds, will produce one ounce of butter; that is, eight quarts will make a pound. I give his statement; but the case will obviously be affected by the length of time which has elapsed from the calving of the animal, by the mode of feeding, and whether it is of the milk first or last drawn from the udder. The celebrated Danvers or Oakes cow, in the United States, which made over four hundred and eighty pounds of butter in a year, — nineteen and one fourth pounds in one week, — and, within my knowledge, sixteen pounds a week for more than three months, and another cow, also within my knowledge, which produced three hundred and thirty-five pounds per year, were evidently of the North Devon blood, though not pretended to be pure. The first cross of the Durham with the North Devon, as I have remarked, produces an excellent milking progeny. Breeding for this object cannot be continued beyond a first cross with any certainty of success.

The Staffordshire long horns, a race which I have not described, but which have always been eminent as milkers, and with which Bakewell began his celebrated improvements in stock, have produced some excellent milkers, by being crossed with the Hereford stock. Two of these animals, owned by a friend, an excellent manager of his little farm, as well as a most highly esteemed clergyman, in Worcestershire, — two characters not unfrequently united, — produced twenty-five pounds of butter per week.

The Kerry cows, of Ireland, — not the very small stock referred to page 178, vol. i., — are greatly valued for their milking properties. Three of these cows, at a milk establishment near Cork, it was stated to me, yielded twenty-one gallons per day, or twenty-eight quarts each. This was at Blarney Castle, but I did not receive it as "blarney." It was stated to me, on respectable authority, that a reverend gentleman in the county of Kerry had, the previous year, as the produce of five cows, sent to Liverpool twenty-five firkins of butter, of sixty-four pounds each, which would be equal to three hundred and twenty pounds per cow. The cows were fed most liberally upon mangel-wurzel. If there be no mistake in the size of the firkin, this is certainly a most extraordinary yield.

I come, lastly, to speak of the Alderneys as a milking stock. I believe it will be admitted, without a dissentient voice, that for richness of milk, as a race, they are unrivalled, and this with scarcely an exception. I shall state some facts within my knowledge in regard to quantity, obtained without any extra feeding. A farmer in Hampshire owned an Alderney cow, which produced fourteen pounds of butter per week, for a period of thirteen weeks. When I visited him in the summer, he had six Alderney cows, which together had produced fifty pounds of butter per week, during the whole season. Another farmer, whose authority is above question, assured me that, from four Alderney cows, he had made, during the months of May and June, fifty-two pounds of butter per week. Colonel Le Couteur, with whose acquaintance I am honored, states that "the best Alderney or improved Guernsey cows give twenty-six quarts of milk in twenty-four hours, and fourteen pounds of butter from such milk in one week. Such are rare. Good cows afford twenty quarts of milk daily, and ten pounds of butter weekly, in the spring and summer months." *

Mr. Bates, the celebrated breeder of short horns, gave me the subjoined minutes respecting some trials of the quality of milk among stock owned by him: —

One quart of milk, West Highlanders, produced 2 oz. butter.
" " " " of half-bred Durham stock, . 2½ " "
" " " " average of short horns, . . . 1 " "

Of some select or extra stock, the following was the result: —

One quart of milk, short horns, produced, . . . 2½ oz. butter.
" " " " of West Highlanders, . . . 2½ " "
" " " " of half-bred Durham, . . . 2½ " "

Of the milk of his famous cow Duchess, a full-bred improved Durham, giving fourteen quarts at a milking, each quart produced one ounce and a half of butter. Supposing the yield at each milking to have been the same, i. e. equal to twenty-eight quarts per day, the amount of butter obtained is shown to have been eighteen pounds six ounces per week. In the case of another cow in his possession, of the same stock, and, I believe, the daughter

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* Journal of the Royal Agricultural Society, vol. v. part 1, p. 50.

of the above, one quart of milk produced two and a quarter ounces of butter, but her yield was not stated.

At Welbeck, at the Duke of Portland's, an Alderney cow, giving three and a half gallons of milk per day, produced fourteen pounds of butter per week. An improved short horn, yielding six gallons per day, produced twelve and a quarter pounds of butter, in the same time.

In a comparative trial between the milk of the Alderney and Kerry cows, detailed in the Journal of the Royal Agricultural Society, vol. ii. p. 420, the result was as follows, as tested by a lactometer.

Portions of cream, 100;	May,	Alderney,	25;	Kerry,	10.
" " " "	June,	"	20;	"	10.
" " " "	July,	"	23;	"	10.
" " " "	August,	"	16;	"	13.

3 pints of Alderney cream gave 1 lb. 8½ oz. avoirdupois.
" " " Kerry " " 1 " 4½ " "

The farmer attributes "the falling off of the Alderney in cream to their being old in milk, and having cast their calves. The Kerrys came into pasture fresh in milk after their first calf."

At a trial of the qualities of milk, on a farm near Liverpool, which I visited, the milk of the several breeds was, in point of richness in cream, as follows: —

Yorkshire and common cows,	as	8	per cent.
Ayrshire, " " "	"	15	" "
Alderney, " " "	"	23½	" "

There is obviously much uncertainty in these trials, from the different conditions, in various respects, in which the cows might have been, and other circumstances.

The average yield of new milk cheese to a cow, in the different counties, is given with great uncertainty. The tenant farmers are, in general, disposed to conceal the favorable results of their husbandry, from the effect it may have upon their rents.*

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* The precision which one often finds in the information given by interested parties, may be illustrated by a dialogue with a tenant dairy farmer, in the presence of his landlord, to which I myself was a party.

Inquirer. "Will you have the goodness to tell me the average yield in new milk cheese, by the year, of a good cow?"

The amount given to me in Gloucestershire was three hundred weight, or three hundred and thirty-six pounds, to a cow; on another dairy farm, admirably managed, and where there prevailed a disposition to give the fullest information, three and a half hundred weight, or three hundred and ninety-two pounds. In a report on Cheshire cheese-making, it is represented at three hundred weight, or three hundred and thirty-six pounds. The writer says, in a few instances, five hundred weight, or five hundred and sixty pounds, are produced to a cow; but these cases are rare. The Cheshire cheese, however, is not pure new milk, as some of the cream from the night's milk is abstracted for butter. In the best cheese district in New England, I have known, in a dairy where a good many cows were kept, the average annual yield of entire new milk cheese to have been, in one case, six hundred and twenty-seven pounds to a cow; in another case, six hundred and thirty-one pounds. This was extraordinary, and showed excellent management. The account may be found in my Report of the agriculture of Berkshire. In general the yield with us, as here, does not exceed three hundred pounds to a cow.

The result of a small dairy farm, where twenty cows are kept, as presented in a late Journal of the Royal Agricultural Society,* gives, as the produce of a cow, three and a half hundred weight of cheese, thirty-five pounds of butter, and thirty-five pounds of whey butter. Considerable amounts of butter made from the

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Farmer. "There is a great difference in cows."

I. "I understand that, and do not wish to hold you to an exact statement; but please let me have your opinion of the average annual yield of cows as they rise?"

F. "A great deal depends on their feed."

I. "I am aware of that; but, to be more direct, will a good cow, well fed, produce one hundred and fifty or three hundred pounds of new milk cheese in a year?"

F. "That is very difficult to answer."

I. "It may be difficult to answer. I do not expect you to be very exact; but a general opinion is all I want. What do you think? Will it be one hundred and fifty or three hundred pounds?"

F. "Some cows will produce more and some less."

I gave up in despair; and yet this man every year sold all his dairy produce in the market by weight. The secret was, his rent was very low, and he was a tenant at will.

* Vol. vii. part 1, p. 183.

whey of cheese go to the market, and bring, within about twopence, the price of whole butter.

(9.) *Improvements in Relation to the United States.* — In thus giving an account of the neat cattle of Great Britain, I have chosen to give my own observations, and facts coming within my own knowledge, rather than to refer to any published accounts. These are as accessible to others as to myself. The facts which an individual circumstanced as I am is likely to collect, unless his attention were exclusively directed to the subject, are necessarily few, and furnish imperfect grounds for him to speak with confidence, which I would by no means be thought to do. That the neat stock of the United States is of a very mixed and miscellaneous description every one must admit. Comparatively few attempts have been made in a systematic manner, and upon an extended scale, for its improvement. Where they have been made, they have frequently failed from want of perseverance, — very often from want of encouragement, — and have been sometimes met with the sneers of ignorance, or the derision of envy. The immense improvements which have been made here strike every observer with grateful astonishment, and are evinced by the accounts which I have given of the progressive size of animals in the Smithfield market. Few subjects, in my opinion, more concern the interests of American husbandry than the improvement of our live stock. Much, undoubtedly, may be done by the selection of the best from our own breeds, and by breeding only from the best; but our stock is so crossed, and mixed up, and amalgamated, that it must be a difficult process to unravel the web, and go back to any original breed. We may certainly, with great advantage, avail ourselves of the breeds existing here in the highest state of improvement. I am quite aware that many very excellent animals have been imported into the United States from this country; and I hope these importations will be increased, and that all pains will be taken to preserve the distinctness and purity of the races, and, if possible, improve them. This can only be done by watchful care, good judgment, and liberal keeping.

In making a selection of breeds, it is plain that regard should be had to the locality where they are to be placed. The improved short horns, the Yorkshire, and the Hereford, are best adapted to the rich and deep pastures of the Middle and Western States; the Ayrshire, and the North Devon, seem to me especially suited to New England; while the West Highland cattle would evidently be fitted to the northern, cold, and least productive parts of the country. Great advantages would, in many cases, accrue from a first cross between some breeds. As I have already said, extraordinarily fine milking animals have been produced, in this way, by the crossing of the Durham and the North Devon, and by a cross of a short horn, even, with an Alderney. An eminent farmer in Ayrshire is accustomed to cross his Ayrshire with the improved Durham breed, and steers of this stock, and heifers, after their first calf, have, as I have seen, proved a most excellent and valuable stock. To proceed further than this has not been attended with favorable results, and is never sure of manifesting the best qualities of their progenitors.

Many persons here have accumulated large profits by breeding very superior animals for sale, and the prices have been often exorbitant. The same results can scarcely be expected in the United States, where the means of farmers are very limited, and few can enter into spirited pecuniary competitions for the mere gratification of taste. But a fair and reasonable profit may be expected, under skilful and careful management.

With us, as well as here, the success of farming must mainly depend upon such a conduct of the farm as shall not exhaust its productive powers; or rather, that it shall, from its own resources, furnish the means, not only of recruiting its strength, but of actually increasing its capabilities of production. There is no more obvious way of doing this, than by consuming the produce of the farm, mainly, in feeding animals, through whom the riches of its vegetation may be returned in a form to furnish other and better crops. The stall-feeding of beef-animals, if the current prices of agricultural produce are brought into the reckoning, appears, almost always, a losing operation. It will often be a serious one, where the animals so fed are of a poor and unthrifty character, or where, as dairy animals, the product is small in quantity, and inferior in quality. It is plain how much the favorable chances of success are improved, when the stock to be fatted are of a kind to fatten rapidly, and to return large weights, and where the yield of the dairy stock is of the finest quality, and given in abundance. The difference between one hundred and twenty pounds of butter and two hundred pounds, as the annual produce of a cow, or between three hundred pounds of new milk cheese and five or six hundred, is of easy calculation. In the attempts to improve our cultivation, to increase our products, and to produce the best, we shall not always succeed; and when we have done all we can, we may fail from causes wholly inscrutable; but we must continually try for success, for we are certain not to succeed unless we do try.

I have never considered farming, under any circumstances, as a source of extraordinary profits, or the means of rapid accumulation; but, under good management, it presents, ordinarily, the means of fair, reasonable, and honest gains. It is a hard case, when, to an industrious and frugal man, it becomes, as it may, a losing concern. Dr. Franklin, with his usual shrewdness, has said, that the thermometer, by which to judge of a man's feelings or enjoyment, is his pocket. When that is empty, the mercury goes down below "zero." With railway speculators, stock-brokers, land-jobbers, and all that class, it may often go up to boiling heat; and in as many instances, it may be found frozen in the bulb. Such extremes disturb all comfort; they always endanger morals; they too often lay waste the human heart, stripping it of its best affections, and make shipwreck of life. With the farmers, at least, I should be glad always to find it, at "temperate." As a means of health, — as a source of rational, and delightful, and innocent occupation, — as a branch of high intellectual philosophy and study, — an enlightened and improved agriculture may commend itself to many thoughtful, and virtuous, and well-governed minds; but to the great mass, in order to stimulate their exertions, and to satisfy purposes which are not unreasonable, it must be a means of comfortable subsistence and profit; and it can only be made so by adopting, pursuing, and, if possible, enlarging by science, experience, inquiry, and practice, the great improvements which have already been made in this first and best kind of human effort.

3. **Sheep.** — In importance, sheep occupy a high place among the live stock of Great Britain. It would not be easy to make a just comparison between the amount of wool and mutton produced and the product of the dairy or the stall; but the number of sheep in Great Britain is very great. The wool finds a

demand in the various manufactures of the country; and mutton and lamb make up an extraordinary portion of the food of the inhabitants.

Size, thrift or disposition to fatten, hardihood, early maturity, prolificness, quantity and quality of wool, are matters of great consideration in these animals. It cannot be said that all these properties have been as yet combined, in the highest degree, in any one kind of sheep; perhaps such a combination is impossible; but the efforts for the improvement of the different races, and, in several instances, the success of those efforts, have been as remarkable as in the improvement of neat stock.

There are no fine-wooled sheep in Great Britain. The fine-wooled sheep of Spain and Saxony have not size enough to meet the demands of the markets for mutton; at least, this is the prevalent impression. Perhaps the merino blood might be engrafted into their flocks, to a certain extent, with great advantage; but they fear the diminution of size. Size and fatness are the principal objects of the British farmer; and, in the latter quality, it would be undesirable to attempt any further advance. The fatness of much of their mutton now renders it almost uneatable.

I do not propose to give a particular account of the different kinds of British sheep, but shall speak only generally, with the exception of the two prominent breeds.

(1.) *Various Breeds.*—The Lincolnshire, the Cotswold, the Dorsetshire, the Gloucestershire, the Oxfordshire sheep, are large, coarse-wooled, and coarse-boned sheep, which have their partisans in particular districts, and are much crossed and intermixed with others, but have not attained the enviable distinction of being, if I may be allowed the term, cultivated and improved, so as to form a distinct and extensively popular race. Their yield of wool is large, averaging six or seven pounds to a fleece, and in some instances more, and of variable price, dependent, of course, upon the caprices of the market, but, in such a country as this, always in demand for coarse fabrics. Some of these sheep, the Lincolnshire in particular, attain to an enormous size. I have seen some which, it was calculated, would weigh, when dressed, above seventy pounds per quarter,—the farmer who was feeding them having already killed some which had reached that amount. I shall subjoin the authenticated account given me of a Lincolnshire sheep, which will show that I do not deal in exaggerations.* The sheep which I saw in the process of fattening, it was thought, would closely approximate the same weight. I may well say, "they were a sight to behold."

That any sheep should be found of the extraordinary weight of the one given below, will excite the surprise of many of my readers. These sheep, however, as a breed, are not distinguished for their thrift, and are not sought after in the market. A small Welsh sheep, the meat of which is particularly liked, though weighing only about ten pounds a quarter, would sooner find a purchaser, and at a higher proportionate price.

The Dorsetshire sheep have the peculiarity of producing lambs twice in the year. On the farm of an enterprising cultivator in Worcestershire, whose farming is of a high order,† it is the custom to breed from Dorset ewes, twice a year,

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* Weight and particulars of "William the Fourth," a two-shear sheep, fed by Henry Healey, Esq., and slaughtered at Brigg, 10th March, 1836.

	lbs.	oz.	lbs.	oz.
Live weight,			434	00
Dead weight,			304	10½
Blood,	11	0		
Skin,	36	0		
Pluck,	8	4		
Loose fat,	34	0		
Entrails,	26	12		
Head,	8	12		
Waste,	4	9½	129	5½
			434	0

Dead weight, 304 lbs. 10½ oz., or 76 lbs. 2½ oz. per quarter.

This sheep clipped sixteen pounds of wool the first time he was shorn, and twelve pounds the second time.

† As I may have no better opportunity, I shall digress here to speak of what this farmer has effected, within a few years, by his excellent management. The farm consists of one hundred and seventy-two acres of fair land, with a varied soil, and when he entered upon its improvement, it was quite "down at the heel." He has increased his average product of wheat from twenty-three bushels to thirty-six bushels per acre, and has sometimes produced fifty-one bushels. His yield of carrots average thirty-six tons per acre, and his mangel-wurzel twenty-five tons. He prefers the Belgian, or white carrot, to any other, being much more productive. This is a general opinion. He keeps twice the quantity of stock which was kept on the farm when he began his improvements; and he sells annually sixty tons of hay. I refer, in this case, to the farmer who cultivates gorse

having two crops of lambs to send to market, the first in December, the second late in the spring. In this case, the ewe and the lamb are both well fed and nourished with much care, as indeed can well be afforded. He stated to me a fact which deserves notice. He has frequently crossed his Dorset ewes with a Hampshire buck; and in this case, the female progeny loses the property of breeding twice a year. I leave the philosophy of this to the physiologists; but the experience of this farmer established the fact. A sheep which will give two lambs a year for the market, and her own fleece, is a profitable animal. The lambs sent to market at Christmas, in a place like London, where persons are always to be found able and willing to pay an exorbitant price for luxuries, can always be sold to advantage.

(2.) *Cheviot and Highland Sheep.* — The next breeds of sheep which are commonly seen in the Smithfield market, and are bred extensively in their proper districts, are the Highland and the Cheviot sheep, — the former at the north, and the latter at the south, of Scotland. Both of these kinds of sheep are of moderate size, and of good shape, weighing, when dressed, from twelve pounds to sixteen pounds, and upwards, per quarter. Their wool, especially that of the Highland sheep, is of very inferior quality, being worth less than half the price of common wool. The Cheviots are excellent mothers; and both of these kinds of sheep show a remarkable thriftiness, when brought from the north to the rich pastures and turnip fields of the south. Their mutton, of the best quality, always commands a high price in

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extensively, for his stock, — of whom I have spoken. This gives him a great amount of food and manure. Besides this, he has the best arrangement for keeping his manure which I have seen in the country. A long shed, open at the sides halfway down, with a floor sunk about two feet in the ground, and the whole walled in at the sides with a brick wall, rising about three feet above ground, with a tight bottom, inclined so that all the drainings of the heap run into a well in the corner, formed the receptacle for his manure. The manure was regularly brought into it from the stables and cow-houses. Thus his manure was effectually protected from the sun and rain, and was accessible, either for deposit or removal. A pump was placed in the well; and as it became full, from the drainings of the heap, the liquid was pumped up, and by a movable trough spread over the heap. It is an important point to secure a manure heap from the drenching rain, as otherwise the liquid running from it becomes greatly diluted, and in such case appears to lose much of its efficacy.

the market, from the resemblance in its taste to venison, and is much sought after for epicurean tables. The Cheviots are white-faced sheep, and much valued. They are never housed, and are left to dig for their food in the bleak pastures, in the depth of winter. Their wool is coarser than that of the South Devon, and is not used in the manufacture of finer cloth. The West Highland sheep and the Cheviots are valuable races for their hardiness. The Highland sheep have black faces, and are horned. They are long and ill-shaped; and the average weight of wool is about three pounds per fleece. They are deemed even hardier than the Cheviots; but they come to maturity later, and the best of them are not killed until they are three years old.

(3.) *Leicester Sheep.* — Of the long-wooled sheep, the Leicester take precedence of all others. This race of sheep owes much of its excellence to the sagacity and skill of the celebrated breeder, both of cattle and sheep, Mr. Bakewell. It was his aim, by careful selection, to combine, if possible, fineness of bone, beauty and symmetry of form, tendency or disposition to fatten, with weight of carcass, and a good yield of wool. In all these respects, it is surprising what he seems to have been able to accomplish; and for roundness and finish of form, flatness and width of back, shortness of neck, fulness of breast, width behind, and depth of fat upon the ribs, the best samples among them are most remarkable.

The success of Bakewell in breeding his sheep, and raising them to a high degree of perfection, is perhaps in no way more strongly evinced than in the fact that "he let his first ram for the season, in 1760, for seventeen shillings and sixpence, and in 1789, he let one ram for one thousand guineas, and he cleared more than six thousand guineas, or more than thirty thousand dollars, the same year, by the letting of others." These fine sheep, either pure or intermixed, are found spread extensively over the kingdom, though they are not well adapted to a cold climate, to short feeding, or to travelling long distances. They cannot, I think, be pronounced a hardy sheep; but many of the long-wooled sheep, of various kinds, have been improved by being crossed with the Leicester. Their yield of wool is from six to seven pounds per fleece, and is valued especially for worsted yarns, and goes into serges and carpets. They are remarkable for their quiet habits, and seem to enjoy life in eating and growing fat. They are not highly valued in Smithfield market, from their excessive fatness, giving a very small proportion of muscle or lean meat, and a large portion of the carcass being absolutely uneatable, except by the most gross and truly Esquimaux appetites.* The Lincolnshire sheep are larger and coarser; but in tendency to keep, and increase in fatness, the Leicesters are beyond all rivalry; indeed, in respect to almost all the other long-wooled sheep, they have been so crossed and intermixed with the Leicester, that it would be difficult to find a pure animal of any one of the original breeds.

(4.) *South Down Sheep.*—The South Downs are an admirable race of sheep. The picture in the front of the Sixth Report gives an imperfect idea of their extraordinary beauty; and their value corresponds with their beauty. Their average yield of wool is about four to five pounds, of a short staple, and of a tolerably fine, and extremely useful quality. Though they have a great disposition to fatten easily, and come to a good weight, such as twenty pounds per quarter, and often exceeding that, yet their fat and lean are well mixed, and the proportion of one to the other in the same animal such as is desired. They have dark faces, short legs, and stand extremely well upon their legs; are broad in the chest, round in the barrel, most compactly and strongly built; with flat backs, and broad and square behind; quiet and good-tempered; much more hardy than the Leicesters, though in this respect inferior to the Cheviot and the Highland sheep; capable of being driven, without injury, two, three, or more miles a day, and used often for treading the new-sown wheat where the soil is thin; and doing the most ample credit to any care or kindness bestowed upon them. Their wool is much inferior in fineness to that of the Saxony or Merino; but for quality and amount of wool, for size and weight, for quality of flesh, and for general hardiness, it would be difficult to find a superior race of animals.

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* That I may not be charged with prejudice, I shall quote here a letter received from an eminent Smithfield salesman, through whose hands, probably, more sheep pass, in the course of the year, than those of any other man. "It is necessary that I should qualify my observations by saying that no doubt Leicester sheep have been of immense service; and some of the best of them are now exceedingly good, having the tendency to fatten more quickly than any others. But you will find my dislike of them is shared by almost all practical men. They certainly have degenerated exceedingly, becoming small and light of flesh, and unsalable from these causes — making but little meat per pound, and weighing but very little. The average weight of those which come to our market is about eight and a half stone, (eight pounds to a stone,) or seventeen pounds per quarter. The truth is, that some persons have paid such close attention to neatness, symmetry, and comeliness of form, that they have lost size, flesh, and worth. They have, however, their advantages, for such is their aptitude to fatten, that it is only fair to admit that more can be grazed to an acre than of other sheep. The cross of a good Leicester ram with a large-framed Down, makes an excellent sheep."

Jonas Webb, Esq. of Babraham, Cambridgeshire, — whose flocks and excellently-managed farm I have repeatedly seen, — having been kind enough to answer fully several inquiries which I proposed to him, I shall give my readers the benefit of his replies. No man is more competent to speak on the subject, for no man's flock in the kingdom has attained a higher eminence.

He has been a keeper and breeder of South Down sheep for nearly a quarter of a century, and laid the foundation of his flock by a selection from some of the best flocks in the kingdom. Since he began his improvements, he has never made a cross with any other breed; and no individual has ever carried off more prizes at the various agricultural and cattle shows, where the premiums are always assigned by judges who are understood to be entirely disinterested, and without any knowledge of the parties to whom the animals belong.

"I classed my sheep into three different tribes, according to the different breeders from whom I procured them, *after I had made various experiments with the stock from each*, varying, of course, according to the frame and constitution, weight and quality of mutton and wool, and the different character which I might require, always keeping in view never to breed from an unhealthy animal, however superior he might be in other respects. I have since been rearing a fourth and a fifth tribe, which I am only able to do by keeping a pedigree of each, and by which means I am able to mix one tribe with another, as circumstances and convenience may require, believing, in most cases, 'like will produce like,' with proper care and watchfulness.

"I consider them to be much hardier than either the Leicester, Lincoln, or any other white-faced breeds, the Welsh sheep and Cheviots excepted, with quality of mutton and wool superior to any of them. The weekly statement of prices in the London Smithfield market will bear me out in this assertion in regard to meat, and the regular wool market in respect to the wool; although, I believe, wool of the first cross between the Leicester and the South Down, from the first clip, is worth, at the present time, fully as much as the pure South Down, for certain purposes. I believe the South Down has more muscle, that is, more lean meat, in proportion to their fat, than any other sheep.

"Their aptness to fatten is very great, at an early age. It has, for many years past, become the custom, in the arable land district, to winter the wether lambs (viz., castrated lambs) upon turnips, rape, &c., with from half a pint to a pint of corn, (pulse or grain,) or oil cake made from linseed, per day, in the fold on the turnip lands, where they are kept as long as the turnips last, say until the middle of April, when they are clipped and sent to market. Many are sold before that time, so that they are disposed of to the butcher at from twelve to fifteen months old, weighing, upon an average, from eighteen to twenty pounds a quarter. I believe they are capable of walking farther for their food, and bringing it to fold, than any other sheep which can be kept in hurdles, keeping the same good condition. As a proof of this, you may see that my flock of ewes often walk from five to six miles per day, backwards and forwards, to feed upon very, *very* poor heath or sheep-walk, and have no artificial food.

"The average yield of wool from breeding ewes is about four pounds each, and from ewe and wether hogs,* from six to eight pounds each, according to their size and keep, and the time of clipping them. On referring to my sheep book, I find the average weight of wool for seven years past, upon sheep of different ages, from one to seven years old, (rams,) varying in number from one hundred and fifty to two hundred, each season, to be about eight pounds each.

"I obtain usually one hundred and ten lambs to one hundred ewes, and often many more. The lambs come generally about the beginning of March. Many persons have them earlier, and many later; and, in a general way, the later they lamb the more they *twin.*

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* A sheep, after one shearing, when a year or a year and a half old, is called a *shear-hog*, or *dinmont*, or *shearling*.

"The ewes are first put to the ram at about nineteen months old. I generally put eighty ewes to each ram; sometimes more; often less, if the ram is aged, or according to circumstances.

"I feed my flock ewes upon stubbles from whence the crops of corn (grain) have been harvested, and upon old seed-layers, (lands laid down to grass,) about the time of putting the rams with them. They are generally together about eight or ten weeks, more or less, according to circumstances. The ewes are shifted about from the stubbles in which are the young clovers, &c., for the following summer, on to old heath, sheep-walk, or pasture, until within a short time of their lambing, if that description of food lasts out, when they are put upon turnips to be eaten off upon the land on which they are grown, hurdled in for that purpose, and receive only a small quantity of them at first, with some hay chaff, or hay and straw chaff mixed in troughs. Some have straw chaff only; or I remove the ewes into a straw yard to pick over the straw, to lodge there at night, and return to the turnip field the next morning. On very bad feeding land, the turnips are often drawn off the land and stored, and the sheep are fed with them upon pastures or in yards. About a fortnight or three weeks after the ewes have lambed, they have what turnips they require, with some hay chaff or straw, and are kept upon them as long as the turnips last, when they are fed with mangel-wurzel, rye sown for spring feed, &c., until the artificial grasses are ready for feeding, upon which the flock continue until the lambs are weaned. This takes place generally about the latter end of June, or the beginning of July, according to the age of the lambs. The lambs are then put upon after-grass from which hay has been cut, artificial grasses, &c., until the turnips or rape are ready to be eaten off, when they are put upon it, and are (speaking of my own) never taken off the land upon which that food is growing, until it is all consumed, the following spring, however bad the weather. The ewe lambs intended for stock have some chaff in troughs besides the turnips, which are not cut, but eaten off the ground. The wether and ram lambs have the same treatment, with the addition of a little corn (grain) or oil cake, or a mixture of them, according to the price, and have their turnips cut for them in troughs. The corn or oil cake is given in small quantities at first, and increased until each receives one pint per day, which is sufficient to fatten them by the time before specified.

"The ewes are often kept until they are nine or ten years old, but not in the regular flock, as they are mostly broken-mouthed and require nursing, especially where they have been kept much upon turnips. The usual time of keeping them, if in a flock, is until they are six or seven years of age.

"I think the first cross with a South Down and a Leicester one of the best I have ever seen, both for mutton and wool, and general usefulness; and as a breeder of South Downs, I recommend to use the South Down ram to the white-faced ewe, as the produce, when fat, is worth more per pound than a cross made the other way, viz., with the white-faced ram and the South Down ewe; but possibly a breeder of Leicester rams would say differently. I believe my assertion will be borne out, that eight lambs out of ten will take most after the male, if a South Down, in color, and a greater number than after the Leicester ram; and the price in Smithfield will determine which description is worth the most per pound, a white or brown-faced sheep. I have stated that the produce, when fat, are worth more per pound, as I consider that all sheep so bred, viz., as crosses, are worth more to fat than for any other purpose, and are certainly excellent sheep. Some crosses have been carried farther to great advantage, without doubt, but it is the exception not the rule. Little doubt exists in my mind, that the breeders of Leicester and other white-faced sheep can and do use a South Down for one cross only, and then breed on from that cross, not by putting the crosses together, but by putting a white-faced ram to the half-bred ewe, and so keep on, from her produce, with the Leicester or white-faced sheep for several generations, by which means they obtain more muscle, more constitution, quite as much or more wool, (if the selection is properly made in choosing the South Down ram,) and I believe the brown color of the male would be quite subdued by the second cross, or the third at most; on the other hand, I believe it has been proved that the stain of the white-faced sheep in a South Down flock, where the experiment has been tried, has never been extinguished. Some will come a little different from others in the same lot. Perhaps some individuals may differ from me in opinion. You asked for mine.

"In making these remarks respecting the South Down sheep, I wish it to be fully understood that it is far from my wish to disparage any other breed of sheep. There may be others equally good for certain districts and localities; possibly better. My object has been to point out the general usefulness of the one, without calling in question the good qualities of any other."

I hardly know what requires to be added to an account of this excellent breed of sheep, so full and explicit as that which has now been laid before my readers, and every word of which rests upon careful and successful experience. Some of the principal breeders of sheep in England have annually a letting of tups or rams, in which their best rams are exhibited, and they are then let, in open auction, to such farmers as choose to hire them for the season, for the improvement of their flocks. I have attended two such meetings, where I found a numerous party of farmers, breeders, and amateurs, assembled, — some coming from a long distance, — the competition spirited, and the hospitalities of the farmer or proprietor, at whose place we met, most liberal.

The first of the two meetings I attended, was at Ingestrie, Staffordshire, the seat of Earl Talbot. The bucks to be let, on this occasion, were superior animals of the Leicester or Bakewell breed, amounting to twenty-four. There were of these twelve shearlings, or animals from whom only one fleece had been taken, and the amounts of these shearings were given as follows: — 7¾ lbs.; 10½ lbs.; 8 lbs.; 8¾ lbs.; 7¼ lbs.; 9¾ lbs.; 8 lbs.; 9 lbs.; 10 lbs.; 8½ lbs.; 11 lbs.; 9 lbs. These sheep were all of a high character. In this case the bidding was private, the offer being privately communicated to the agent for the sale, who first announced to the bidder the price at which the individual sheep was held, and then took the highest advance upon that price, the buck too, upon which he bid, being known likewise only to the agent. This method gratified the secretiveness of those who wished to conceal their bargains, and at the same time induced the hirers to name at once their highest offer. The company, which was numerous, afterwards dined together in the palace hall. His lordship himself presided at the dinner.

At Mr. Webb's, at Babraham, Cambridgeshire, the bucks to be let amounted to 177, which were all numbered and tied upon the ground, for the examination of the company. The number of each sheep was given upon a list exhibited, with his age, the amount of wool yielded by him, and the price at which his letting was fixed. At an appointed hour, each sheep was brought into the ring, the lowest price named, and the competition began by an advance upon the price stated. If not taken, his letting was afterwards the subject of private negotiation. In some cases, there was a large advance. After the letting, the company, consisting of more than two hundred noblemen, gentlemen, and farmers, sat down to a bountiful entertainment, provided by the host, in a *marquée* erected for that purpose. Mr. Webb stipulated to convey the animal sold, at his own expense, half the distance, if it did not exceed one hundred miles, and to take all the ordinary risks. I subjoin the list of 1846, including number, prices, and weight of wool, thinking it may be curious to my readers.

Number of Bucks, Weight of Wool, and Prices of Letting for the Season, at the Tup Show of Jonas Webb, Esq., Babraham, Cambridgeshire, July, 1846.

No.	Prices of Letting.		Weight of Wool. lbs.	oz.
	Seven Years old.			
2	£36	15s.	8	4
	Six Years old.			
5	£5	5s.	7	0
6	8	8	8	0
8	10	10	8	0
	Five Years old.			
9	£17	17s.	8	0
10	8	8	8	4
11	12	12	9	0
	Four Years old.			
14	£42	0s.	8	8
18	6	6	8	0
19	0	0	9	0
20	10	10	7	12
21	7	7	8	8
22	18	18	7	8
24	8	8	7	8
25	8	8	7	8
26	6	6	9	0
28	10	10	8	4
30	7	7	6	12
31	52	10	9	8
32	26	5	7	12
33	42	0	9	0
35	10	10	7	12
	Three Years old.			
38	£8	8s.	8	12
39	7	7	9	0
40	5	5	7	8
41	10	10	7	4
42	5	5	7	12
43	7	7	8	0
45	15	15	9	12
46	6	6	8	0
47	7	7	8	0
48	10	10	8	8
51	15	15	9	0
53	15	15	8	8
55	14	14	8	4
56	21	0	7	4
57	17	17	9	8
58	18	18	7	4
59	18	18	8	8
60	16	16	9	8
61	21	0	9	0
	Two Years old.			
62	£7	7s.	6	4
63	15	15	8	4

No.	Prices of Letting.		Weight of Wool.	
			lbs.	oz.
64	£10	10s.	7	8
65	6	6	6	8
66	11	11	9	8
69	18	18	8	12
70	10	10	8	0
72	15	15	8	4
73	15	15	7	8
74	24	3	10	8
75	8	8	9	0
77	18	18	7	0
78	10	10	8	0
79	10	10	7	8
80	8	8	8	0
81	6	6	7	0
82	6	6	8	0
84	8	8	8	0
87	16	16	7	0
88	18	18	8	4
89	21	0	7	0
90	12	12	8	0
92	52	10	9	8
93	31	10	9	8
94	52	10	8	8
95	26	5	7	8
96	31	10	9	0
97	26	5	9	0
98	26	5	8	4
99	42	0	8	4
101	21	0	8	0
	Yearlings.			
105	£10	10s.	7	12
106	5	5	6	8
107	6	6	7	4
109	7	7	6	12
110	9	0	6	12
111	13	13	7	8
113	12	12	8	0
114	7	7	7	8
117	18	18	8	12
118	8	8	8	0
122	5	5	6	0
123	10	10	7	12
124	£21	0s.	7	0
125	8	8	7	12
127	11	11	7	8
129	6	6	7	8
131	11	11	8	0
132	8	8	8	0
133	8	8	8	0
134	11	11	8	0
135	7	7	6	0
138	10	10	8	4
139	12	12	8	0
140	14	14	7	0
141	9	9	5	12
142	15	15	7	8
143	10	10	7	8
144	10	10	8	0
145	9	9	7	0
146	16	16	8	0
147	26	5	7	12
148	18	18	8	0
149	15	15	7	0
150	21	0	7	0
151	31	10	8	8
152	26	5	8	4
153	31	10	7	4
154	26	5	9	0
155	23	2	7	12
157	15	15	7	4
158	14	14	8	8
159	16	16	8	4
161	0	0	8	8
162	0	0	8	0
163	42	0	7	12
166	47	5	8	4
169	42	0	9	0
170	36	15	8	0
172	26	5	7	4
173	26	5	8	8
174	31	10	7	0
175	26	5	9	0
176	42	0	7	8
177	31	10	9	0

The character of Mr. Webb's flock is above all praise; and I could wish to see this breed of sheep extensively spread in the United States. Of the character and demand for the wool, the manufacturers are the proper judges. As mutton, they are preeminent, — combining with extraordinary fatness a fair proportion of lean meat, — and in taste, deemed equal to the Highland sheep. We, I think, as a people, have yet to acquire a taste for mutton. In this respect, we differ altogether from the English, with whom, in spite of all we hear about "the roast beef of old England," mutton seems every where the preferred dish. The immense quantities of poultry, likewise, which are brought to our markets, will stand in the way of other meats; yet our markets, especially in our large cities, are likely to furnish a steady and increasing demand for mutton; and wherever they can be reached, I believe that no breed of sheep are so likely to meet and constantly stimulate that demand, as the beautiful mutton of the South Down sheep.

(5.) *General Management of Sheep.* — I must remind my friends in the United States, that excellence in any department of husbandry has not been reached here, and can no where be sustained, without persevering efforts, and an extreme watchfulness and care. Sheep here are never left to take care of themselves, but have always a shepherd with them, — commonly a boy or an old man, — by day, and are carefully folded at night. The fatting sheep, while the artificial feed remains, are fed in folds.* The general impression with us, I know, is, that they are turned into a field of unpulled turnips, and left to gnaw them into the ground; but this method, unless the turnips are very small, is not much practised or approved. The turnips are generally drawn for them, cut up by a machine, and placed in troughs. This is especially important in respect to Swedes. An experienced farmer in Nottinghamshire informed me that he was averse to giving Swedes to ewes in milk, when their lambs were young, as he found that it made the milk of the ewes too rich for the digestion of the lambs. He therefore aimed to have some white turnips in reserve for the ewes at lambing time. I put this down as the result of his observation, without any other confirmation of the fact.

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* "It is the custom for almost every grazier to have sheep follow on the grasses after the beasts. It is true, our system of feeding the majority of sheep is much altered. The increased population demands it should be. It was formerly the practice to let the sheep graze, and have the lean nourished by degrees, until they were two years old; but now the plan is, to feed sheep as highly as they will bear, to make them fat as lambs, keep them so, and bring them to heavy weights at one year old. The sheep fed in this way leave a great profit; but the principal inducement to adopt this plan is for the advantage which the land derives. You are aware that nothing will produce such a crop of grain as a turnip field eaten off by sheep folded upon it, especially with the addition of oil cake and grain." — *Extract from private Letter.*

Experiments were reported to me, on a farm which I visited, from which it would appear that feeding sheep for fatting in a dry shed, upon a raised floor, and where they were protected from the weather, was attended, on a strict comparison with those fed in an open field, with a great saving of food, and a large increase of weight. Other experiments of a similar kind have not resulted so satisfactorily, as fully to establish this point. The subject deserves further trials. In all attempts to fatten animals, a principal object should be to make them comfortable. Sheep will bear, without apparent suffering, almost any degree of cold; but they often suffer from wet, and especially from a wet lodging. Where a shed open at one side, to which they may resort at their pleasure, is connected with a dry fold yard, the best arrangement seems to be attained. Difference in climate is to be considered. In England, the winter is temperate, and generally wet; in the United States, it is dry and cold. In some experiments reported, it would appear that sheep do better when the turnips are given to them unwashed, than when given in a perfectly clean state. I have seen some human lambs, unwashed and uncombed, the very examples of vigorous growth, of muscular energy, and of ruddy health if you could get at the true color of their cheeks. I have not been accustomed, however, to attribute their remarkable healthiness to the dirt in which they lived. The above statement, in respect to sheep, may possibly be true, or it may be a mere excuse to one's conscience, for not an uncommon reluctance to pains-taking and labor.

Of one point I hope my American readers will not lose sight; and that is, that the extraordinary fatness and thrift of the English sheep is not acquired without an abundance of succulent food, and with this their fattening goes on as well in winter as in summer.[*]

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[*] I have referred several times to the use of oil cake, in fattening both sheep and neat-stock. Perhaps I shall have no better opportunity of saying, that a

4. Swine. — I have seen no individual hogs, and no breed of swine, in any respect superior to those which abound with us. They are not kept to a great extent, or in large herds, and most of them are killed very young. There is no pork, excepting that for navy and shipping purposes, salted and packed down, as with us, in tubs; but with the exception of the lean meat, which is eaten fresh, or made into sausages, the hams are *baconed* and slightly smoked, and the sides or flitches, which alone are called *bacon*, are cured very much as the hams are, and then hung about the wall in the farmer's kitchen, very consolatory under the apprehension of scarcity, but to my taste nowise ornamental.*

The best hogs which I have seen are the Essex White, — raised by a distinguished breeder, Mr. F. W. Hobbes, — the Berkshire, and the Neapolitan. These are often crossed, and variously intermixed. The hogs of a most successful farmer in Cornwall, to whom I have before referred, were a mixture of the Essex,

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valued friend of mine, Thomas Spencer, Esq., of Bransby, Lincolnshire, most kindly remembered by many friends in the United States, has applied, with success, a new article to the fattening of his cattle. He obtains from the grease-receivers and soap-boilers, in London, large quantities of their refuse, with us called *scraps*, here provincially called *brassin*, which in the process of manufacture is pressed into cakes, and sent to him in that form. He uses this steamed or heated, and mixed with turnips, chopped hay, and meal, to give to his fattening cattle, and finds great advantages from it. It requires some little time to induce them to eat it. Some of the best feeders of swine whom I have known have always deemed it necessary to give them, with their farinaceous, a portion of animal food. The hog, however, is a universal and indiscriminate gourmand. Cattle being wholly graminivorous, might be supposed to be averse to animal food; but the appetite can be trained; and we may find a solution of the case in the great doctrine, that "all flesh is grass."

* The pork which is principally sold in the London markets is very small. A good deal of it comes from Ireland, from the pigs of the poor cotters, who depend upon the pet pig to pay the "rint." A principal dealer informed me, that formerly his customers would be glad of a side of pork which would weigh two hundred weight; now they are averse to it, if it exceeds fifty pounds. This pork is very slightly salted. The hams and flitches are not always smoked, but simply cured and dried, and in that way generally preferred. The American hams are deemed too large for the market, and are objected to as not cut with sufficient neatness.

The objection to the lard from the United States is, that it is too soft. Whether this be owing to the feed upon which the swine are fatted, or the mode of preparing the lard, it would be worth while to inquire. The Irish are said to give hardness to their lard, of which great quantities are imported, by the intermixture of a portion of mutton tallow. From Ireland it usually comes in bladders of five to eight pounds' weight, a form much preferred to kegs.

the Neapolitan, and a boar which he had imported from the United States. They were customarily killed at one year old, weighing from fifteen to seventeen score pounds. Some which I saw at two years old, he calculated would weigh thirty-five score. He has killed some which weighed thirty-six score. These are very extraordinary weights. His hogs go in the pasture from April until October, and have no other feed. In the autumn they are put up, and fatted with steamed potatoes, mixed while warm with barley meal. Twelve gallons of barley meal he deems sufficient for fattening a hog fed in this way. They are watched by a hind, who supplies them as often as their troughs are empty, and as he can induce them to eat. His practice corresponds with that of a successful farmer in Vermont, which I shall detail to my readers. His hogs were kept in his pastures from spring until autumn, during the grass season, without other food than, at night, the slops or refuse of the dairy. In the autumn they were brought into warm styes, and were continued to be fed upon hay, chopped and steamed for them, with a very small quantity of corn meal mixed with it. In this way he made excellent hogs, and at a cheap rate. One acre of land was sufficient to support six hogs. He occasionally changed their pasture. He deemed hogs kept in this way a more profitable stock than sheep, — a discovery which, I think, will surprise many feeders of swine.

CIX. — DAIRY HUSBANDRY.

England has long been celebrated for its dairy products, at least for the quality of its cheese; and this is often of a superior description.

1. Butter. — The butter in England is, much of it, delicious, especially that which is made in private families, where it is churned from new and sweet cream every morning, and brought fresh from the churn to the breakfast table; and more particularly when the butter is made from the cream of an Alderney

cow. The common market and shop butter, however, is of the same various character with that in our own markets, with no larger proportion of very excellent butter than is to be found in the markets of Boston, New York, and Philadelphia. Indeed, much of the butter found in the market of the last-named city, for its freshness and deliciousness, is no where surpassed. The butter in England is generally sent to market fresh, and you are left to salt it at your pleasure, as you use it. The salted butter, in tubs or firkins, is mostly imported from Ireland, or the Continent. Even this, however, is not heavily salted. In most of the markets, a good deal of butter made from the whey of cheese is sold at a reduced price. It is of inferior taste and quality, and is bought by the poor, or to be used in cooking, where, like a good many nameless things, it may be thoroughly disguised, and pass without detection.

The Dorsetshire butter, which stands at the head of the market, comes packed in neat casks of about thirty pounds each; but is very lightly salted, and of course will not keep long. It is likewise sent up to London in lumps, perfectly fresh for the table. Its quality is excellent. The table butter likewise, from Epping, and especially Aylesbury, is of the best description.

The Devonshire butter is almost universally made by first heating the milk, just so much as to cause the escape of the fixed air. In twelve hours the cream is all brought to the surface, and in a state of consistency to be easily taken off. It is a disputed point, whether as much butter is obtained in this way as by the ordinary mode of letting it stand, without being heated, a much longer time. The butter is thought to acquire in this way a peculiar taste, but it is by no means unpleasant. The skimmed milk remaining is perfectly sweet, and appears the richer for being heated. In this way is obtained the famous clotted cream which is to be found on the hospitable tables of Devonshire, and is a great luxury.

Glass milk-pans, made of bottle-glass, are much approved, and, with proper care, are in no danger of being broken. They recommend themselves by their cleanliness and incapacity of rust, or corrosion, or decomposition. In some dairies I found shallow leaden troughs used for setting the milk, with a tap at the bottom, so as to draw the milk off and leave the cream. Some persons maintain that, the more shallow the pan, the more cream in proportion will be obtained; but in a large dairy in Scotland, the milk is always set in deep casks and tubs. Such is the diversity of opinion every where prevalent. The Scotch had no fears that the cream would not find its way to the surface unless the principle of gravitation were to be reversed. One of the best dairy women in the country never suffers any water to be applied to the butter when taken out of the churn, a practice not uncommon.

2. CHEESE. — English cheese has long been celebrated for its excellence, but it is far from being all equally good. The Stilton cheese stands, by general admission, at the head; the Cheshire, the Cheddar, the Gloucestershire, and the Wiltshire, have their different partisans, and though they differ from each other, are preferred according to the particular tastes of those who eat them. The celebrated Dunlop cheese of Scotland, which is certainly excellent, is made with one fourth part of ewe's milk.

It cannot be expected that I should go into all the processes of the dairy. My remarks must be general. All dairymen seem to agree, that, in cheese-making, much depends on the character of the soil upon which the cows are fed. Wet and low grounds, producing a rank and coarse herbage, are unfavorable, and so are the artificial grasses given to the cows green. An old pasture and a dry soil are most desired; and it is said, that the poorer the pasture, the better the cheese. Wet and cold pastures have been converted into good cheese grounds, by thorough draining and cleaning. The quality of the cheese depends, more than upon any thing else, upon the skilful and careful management of the dairy-maid herself. This is to be learned by practice, and very little useful direction can be conveyed in words. The making of cheese is a chemical operation. We shall be glad when chemistry is so applied as to determine the rules by which success may be made certain.

The average quantity of cheese made is reckoned at one hundred and twelve pounds to one hundred gallons of new milk. Few cheeses are made wholly of new milk, being, in general, what are called *two meal* cheese, and the cream being taken off the previous night's milk, to be converted into butter. In this case, according to the practice of an excellent Vermont farmer within my knowledge, the buttermilk would go back to the cheese and serve to enrich it. The cheeses, in general, are made very hard, which is owing, in the first place, to cutting the curd very fine, and next, to the severe pressure which is given to them. The rennets are here called *vells;* and the best are imported from Ireland. At one of the principal dairies which I visited, it was customary to put six skins, at the beginning of the season, into two gallons of brine, and use this liquid for forming the curd, in such quantities, and at such time, as required. A quantity of lemon was also put into the liquid, to correct the taste and give it a flavor; but I believe with no advantage to the cheese. It is strongly urged not to use the rennets until they are a full year old, as otherwise they cause the cheese to heave and to be full of holes. In most dairies, it is customary to scald the curd with hot whey, but by the best dairy-women this is disapproved, as tending to impoverish the cheese. The coloring the cheese with anatto is not universally practised, nor does it much benefit the sale, where the character of the dairy is known.*

I received from two sources, where the cheese was of the first quality, two recipes for making Stilton cheese, and one for making Cheshire, which I shall subjoin.

(1.) *Stilton Cheese.* — "To fill one of the Stilton moulds, take nine gallons of new milk, and one gallon of cream. Take

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* Several questions have been proposed, by a respected correspondent, on cheese-making. I shall answer to the best of my information.

The skins for rennet are to be procured a year before they are wanted; to be cleaned of all impurity; to be turned inside out and salted; to be then packed down one upon the other in salt, with a layer of salt between each; and then covered with salt and shut up. As they are wanted, a month before being used, they are to be taken out; the brine drained from them; spread and powdered with fine salt; rolled out, and distended upon sticks; and hung up to dry.

The temperature of the milk, when the rennet is applied, should be from 80° to 84° Fahr. The dairy-women in some parts of the country, who make very good cheese, make their cheeses cold, that is, coagulate at a very low temperature. This cheese is said always to meet a quick demand. They likewise salt them but lightly.

The curd is broken by a machine, being formed of projecting teeth set upon a cylinder; and the curd, being placed in a kind of hopper, passes through them and is ground fine.

An hour, or an hour and a half, is thought the proper time for the process of one quart of marigold flowers, and pound them very fine in a mortar, and then stir them into two quarts of boiling water, and let them stand five minutes. Then strain off the liquid into the cream, and pour it into the milk. Put in the rennet. When it has come into curd, take a cheese-cloth and put it into a sieve, and raise the curd with the hand into the sieve, and let it drip until it is firm enough to be put into the mould. When first put into the mould, press it with small weights for two hours; then apply a dry cloth to it, and put it under the press; and salt it every twelve hours for three times. When taken from under the press, put a bandage of calico around it for several weeks, until it gets quite firm."

(2.) *Improved Stilton Cheese.* — The subjoined is an account of cheese made by a superior dairy-woman in Lincolnshire, in imitation of Stilton, which the writer, a most competent judge, pronounces superior to any Stilton cheese which he ever tasted: —

"The utensils are the same as those used in the manufacture of the real Stilton, excepting the cheese-vat, which in this case is a plate-tin cylinder, without top or bottom, having the sides pierced with holes, to let the whey escape. The rennet is made

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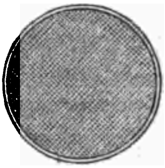
coagulation of the milk. If the coagulation is rapid, there will be less curd, and it will be tougher; if slow, more in quantity, and more tender in quality.

Another machine is used in some dairies, which is called a *curd-breaker*, being a kind of sieve made of wire with a strong tin rim, as represented in the margin. This cuts the curd by being carefully and gently pressed down upon it into the tub. After this, the curd is left for the separation of the whey from it, which is dipped out with a dish, or otherwise removed by the raising of the curd by the gentle lifting of the hand. A board full of holes is made to fit the top of the cheese-tub, and placed upon the curd with a moderate weight upon it, which is afterwards increased, and the tub turned on one side, for the draining of the whey from it. The weight must not be too severe, or the curd will be robbed of its richness.



To determine when the curd is fit for breaking, is matter of judgment or experience. Examination will decide when the coagulation is complete; — the whey becomes of a pale green.

The quantity of salt recommended is one pound to forty-two pounds of curd.

The lever press for the curd, and for the full-formed cheese, is preferred to the screw press, from its tendency to adjust itself.

A full and detailed account of making Cheshire cheese is given in a Prize Essay by Henry White, in the Journal of the Royal Agricultural Society, vol. vi. part 1, which I wish some of our excellent agricultural papers would republish.

in the same way as usual, only, instead of the stomach of the calf, that of the lamb is used, and, in addition to the usual quantity of salt, a lemon stuck full of cloves adds to the efficacy of the rennet, and gives it a flavor.

"As much as is needed of the morning's milk, as it comes from the cow, and the cream of a fourth part of as much milk of the evening before, are taken to make a cheese. The rennet is put to it in the usual way; and when the milk has become curdled, it is not broken, as here and elsewhere, with a cheese-knife and disk; but the surface of the curd is merely pressed down with a dish, — not broken; and as the whey arises, it is taken off; and this operation is continued until no more appears. The mass by this time is not one fifth of its original size. A long, thin, clean, and dry cheese-cloth is then provided, and the curd is tumbled out of the vessel upon it; and the four corners of the cloth are gathered together, and tied together, and hung up over the vessel; and the remaining whey is pressed out of it by its own weight. It remains in the cloth for some time, until it gives over weeping, when it is taken out of the cloth, and cut into thin, long, narrow slices, about the size of sticks of sealing-wax. As these are cut, they are placed inside the tin cylinder, which is now placed on one of its ends, on another clean and dry cloth on the table. First, a layer of these slices is placed, filling up the whole of the bottom end; and on the top of this, another layer of slices is placed at right angles to the last; and a succession of others is thus continued, pressing them gently down, till the cylinder is quite full. When this is done, the cloth is gathered round the outside of the cylinder; another person takes hold of the cylinder, with one hand lifting it up, while, with the other, the curd is pressed out into the cloth, which, with the curd in it, is then returned to the cylinder, and pressed down as closely as possible with the hand. Next morning, the whole is taken out of the cylinder, and put into a clean, dry cloth, upside down, and again placed in the cylinder. This is repeated twice a day, always reversing the young cheese in the cylinder. When it becomes so firm as to do without the cloth around it, a wrapper of thin dry cloth is put round it every morning, when it is placed in the cylinder, till it be so dry as to do without the cylinder, when the wrapper *only* is used, and it is left on a shelf.

"There is a great deal of trouble with this kind of cheese, from the constant dampness of the skin; — the sides are apt to get fly-blown, when maggots are the result, and the cheese is injured. The object of cutting the curd into thin slices, and placing them in alternate layers, is, that it may more readily get mouldy, and acquire the peculiar character of good Stilton — brittleness with softness, richness, and mouldiness. In Rutland and Leicestershire, where the Stilton cheeses are made, the plan adopted is the same as that of the Dorset farmers in making their poor green Dorset cheese, that is, by inoculating the curd with some old, mouldy cheese. The cheese is of poor character, made up of half-creamed milk.*

"The cheese is salted by rubbing salt in the sides of the cheese, when it has its swaddling bands removed, every day. This cheese takes at least eighteen months before it is fit for the table. The details I have given are those descriptive of the manufacture of the best Stilton."†

I shall give next the directions, in her own words, of an excellent dairy-woman, whose produce proves her skill for making

(3.) *Cheshire Cheese.* — "Take thirty gallons of new milk to make a good-sized cheese, and then put the rennet into the milk. When come into curd, break it up very small; then bring it together into one side of the tub; then dip the whey from it, and put it into the cheese, with a cloth inside of the vat, and put it under the press one hour; then take it out and break it up very small, and warm a small quantity of whey and pour over the curd, and stir it around; then take the whey from it, and put the curd into the vat again, and squeeze it well with the hand. When putting it in the vat the last way, take a small quantity of salt, and put into the middle of the cheese, and put it under the press. Apply dry cloths to it several times, and salt it every twelve hours for four times. A little flour is a very good thing to put in the middle of the cheese with the salt — about one table-spoonful."

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* In my inquiries, in Gloucestershire, of an eminent dairy-woman, what method they adopted to prevent the cheese from *heaving* or bursting, she, with a little gentle stammering, and rather a threatening scowl from her husband, informed me that "they sometimes put in a little *white lead.*" *But "they did not put in much, and they did not know that it did any harm."* Of course, as it went to London market, they could not know whether it did harm or good. It might have been well to have inquired of the doctors or the undertakers. Arsenic would have been more certain in stilling all complaints of the quality of the cheese.

In Cheshire, it was much more common than it now is, to put a handful of pins in the centre of the cheese, to create a mouldiness, and give an appearance of age. What would be the effect of the decomposition of the metal in such cases? The chemists might tell us.

With such ingenious medicaments applied to our food, we have great reason to say, in respect to our bodies, with good Dr. Watts, —

"Strange, that a harp of thousand strings
Should keep in tune so long!"

† Private letter of John Morton, Esq. to H. C.

What the use of the flour is in this case, it would be difficult to say. It may be like the horse-shoe upon the door-post. But I choose to give her directions verbatim and in full. Her cheese is of the best quality, and her dairy-room a model of neatness and order.

A great deal of American cheese has already come, and a great deal more is likely to come, into the English market. Much that has been sent has been highly approved; and the cheese-mongers say, there has been an evident improvement in the quality since the first importations; but much of it is disliked, and none of it has yet reached the highest price in the English market. This, I believe, is partly owing to prejudice; for it is very difficult to convince an Englishman that any thing out of his own country, or the product of a foreign country, is as good as that which he finds in it, — a prejudice not exclusively English. But it has some foundation; — the American cheese has too commonly a smartness or acridness, which is disagreeable, and is not found in the best English cheeses; and, in the next place, the cheese-mongers state that the cheese is often heated on its passage, and in that way essentially injured. For the latter evil there would be a partial remedy in packing the cheese in separate boxes, which is now often done, and in not sending them in too green a state. The former evil is in the making of the cheese, and in applying too much rennet. I give this as the opinion of a very competent judge. He himself has so well succeeded in the manufacture of cheese, always deemed of the very best quality, that I shall put down, for the benefit of my readers, the suggestions which I have received from him in conversation. The subject, in the present open and friendly relations between the two countries, is certainly one of great importance to the American dairymen.

He advises, in the first place, that the calf from which the rennet is to be taken should not be allowed to suck on the day on which it is killed. The office of the rennet, or stomach of the calf, is, to supply the gastric juice by which the curdling of the milk is effected. If it has recently performed that office, it will have become to a degree exhausted of its strength. Too much rennet should not be applied. Dairymaids, in general, are anxious to have the curd "come soon," and so apply an excessive quantity, to which he thinks much of the acrid taste of the cheese is owing. Only so much should be used as will produce the effect in about fifty minutes. For the reason above given, the rennet should not, he says, be washed in water when taken from the calf, as it exhausts its strength, but simply salted or dried in the usual way, or otherwise preserved in pickle.

When any cream is taken from the milk to be made into butter, the buttermilk should be returned to the milk of which the cheese is to be made. The greatest care should be taken in separating the whey from the cheese. When the pressure or handling is too severe, the whey that runs from the curd will appear of a white color. This is owing to its carrying off with it the small creamy particles of the cheese, which are, in fact, the richest part of it. After the curd is cut or broken, therefore, and not squeezed with the hand, and all the whey is allowed to separate from it that can be easily removed, the curd should be taken out of the tub with the greatest care, and laid upon a coarse cloth attached to a frame like a sieve, and there suffered to drain until it becomes quite dry and mealy, before being put into the press. The object of pressing should be, not to express the whey, but to consolidate the cheese. There should be no aim to make whey butter. All the butter extracted from the whey is so much of the proper richness taken from the cheese. These suggestions seem to me reasonable and valuable. I should be glad if our farmers could send the English even a much better article than that which they produce themselves. I should be glad to overcome every prejudice, on whichever side of the water it might be found, and transform the union of mutual trade into a perfect union of mutual good-will, between two nations, whose joint interests interlock each other in a vast variety of forms, and may be made to fit together like the different pieces of a dissected map.*

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* In conversation with one of the largest wholesale cheesemongers and provision dealers in the country, he suggested that there were two great faults of the American cheese, which somewhat prejudiced its sale in the English markets. He is a person in whose character and experience entire confidence may be placed.

He was pleased to say that he had had cheeses from the United States as good as any he had ever seen, and that the general character of the article was greatly improved since the first importations.

But the first fault was the softness of the rind. It often cracked, and the cheese became spoiled from that circumstance. This he considered as owing to the cheese being too rich; if so, it is a fault which may be remedied. The English cheeses soon acquire a great firmness; and I have given above the opinion of an English dairy-woman as to how this is effected. I think proper, however, to add the directions of a most experienced and successful dairy farmer in respect to this matter. He says that the rind may be made of any desired hardness, if the cheese be taken from the press, and allowed to remain in brine, so strong that it will take up no more salt, for four or five hours. There must be great care, however, not to keep it too long in the brine.

The second fault is the acridness, or peculiarly smart bitter taste often found in American cheeses. He thought this might be due, in part, to some improper preparation or use of the rennet, and, in part, to some kind of feed which the cows found in the pastures. Both these matters are well worthy of investigation, and that alone can determine.

He was of opinion, likewise, that American cheese would sell better if it were colored like the English cheese. The market for it was fast becoming most extensive.

In respect to American butter, he considered that which usually came here as a most inferior article. (Much of it, I believe, is used, in the manufacturing districts, solely for greasing machinery.) Salt butter, or butter strongly salted, is not salable in the English market; and especially the salt must not appear. I cannot doubt, however, that presently some of our best June or September butter, put up in lumps, would find a good market here, — if, in truth, we have any to export. The very best fresh butter in London market, however, does not bring so high a price as I have often paid for the best article from the county of Worcester, in Boston market; and I have frequently known the best butter to be sold in Baltimore, and even in Cincinnati market, for half a dollar, a little more than two shillings sterling per pound.

I have seen in England none of the admirable *spring-houses* which are to be found in Pennsylvania.

CX. — MANURES.

The subject of manures, in British husbandry, is one to which I cannot attempt to do any thing like justice, in an examination of this nature. It would require a large volume to treat it properly, rather than a few pages of a single report. I shall not enter at all in this place upon the philosophy of manures, but merely refer to some few which are in use.

Of course, under any improved condition of husbandry, all possible pains will be taken, to secure in the best manner the various resources of the farm itself; and yet I have seen here no place in which this provision is complete, or in which more might not be done than has been done.

In most cases, the stable manure is left in the barn-yard uncovered; and I have not met with a single barn cellar for receiving manure, in the whole country. In general, the barn-yards are square, with the sheds extending round three sides of them, and the yard scooped out in the centre; but it is not until recently that they have found the advantage of putting gutters and spouts to their farm buildings, for the prevention of the rain flooding the manure in the yard, and thus exhausting its strength. In only one case — and that I have described — have I seen a shed and pit under it, for the protection of the manure. I have presumed sometimes to describe to the farmers the excellent barn cellars on many of the farms in New England, where the stable is built on a side hill, and all the manure is shovelled through a trap door behind the cattle, into a well-walled cellar, made tight at bottom, and opened by a gate at one side or end, for the purpose of removing the manure; and where a certain number of store swine are kept, who, by constantly rooting among the manure and stirring it, keep it from heating excessively, while they intermix it thoroughly, and reduce it to a fine state; and where, too, the whole is protected from the wasting influences of the sun and rain, and is always in a condition to be applied to the field. Where the flatness of the land and the wetness of the soil would prevent making a cellar, the barn or stable might be of two stories in height, and the cattle kept on what with us is called the *second story*, but here always the *first floor*.

In many cases, I have found provision for saving the liquid manure of the stables in a tank or cistern, from which it is either returned to the heap, or carried to the fields in a watering cart. I have already described a prominent example of this kind. The barn manure here is always carried to the side of the field on which it is to be used, and there it is formed into a long heap, in the neatest manner, and frequently covered with earth, so as to protect it from the weather. I have, in no case, seen long manure applied green from the stables. It is not, however, deemed best to keep it too long, or to reduce it to a very fine muck, by which its strength would be exhausted; but it is always shovelled over once or twice, that it may be in a condition easy for distribution. The quantity to be applied to an acre is subject to no fixed rule. The land, as I have described, is well dressed once in a four years' rotation, besides the consumption of one of the crops by folding, and perhaps of another by grazing.

Of the various artificial manures, which are manufactured and usually patented, I shall give no opinion. Any of the advertisements in the papers of the venders of quack medicines, if only the name of the article be changed, would serve for the advertisement of most of the new patent manures, they being adapted to all cases, and certain to cure all diseases. The adulteration of manures is carried on to an enormous extent. No man purchasing a valuable manure one year is certain to find it the same the next. An eminent professor of geology stated, at a public agricultural meeting, that much guano sold was mixed with ninety per cent. of foreign materials: Saltpetre is full charged with common salt; and large amounts of guano, in several of the principal markets, have been manufactured entirely out of home materials. This is not an agreeable picture of the morals of trade, nor should it be inferred that this is a general character; but in so large a commercial country as this, with appetites whetted by gain to the highest degree of voracity, it is not surprising that all kinds of villany should be practised.

1. Guano. — Guano still maintains its reputation. No new facts have transpired respecting it, but old ones have been confirmed. It continues to be applied, at the rate of two hundred and even four hundred weight per acre, to various crops, with

signal success, unless its efficacy is suspended or defeated by drought, or unless it comes in immediate contact with the plant, when it proves fatal. It is never safely applied alone, and the preferred mixture is a very liberal proportion of mould. Its mixture with ashes, strongly recommended by some farmers, is, as I have before observed, of questionable expediency. In Devonshire, I witnessed the most extraordinary effects from it, this year, applied at the rate of about three hundred weight per acre, upon grass land. The extreme luxuriance and richness of the grass, where it was applied, were most remarkable, especially when seen in contrast with parts of the field not guanoed. Nor is its efficacy limited to one year, but continues for a length of time as yet not determined. But were its obvious effects limited to one year only, yet the increase of crops growing out of its use furnishes, in itself, the means of greatly enriching the farm.

2. THE NITRATES. — The nitrates of soda and of potash, from which so much was at one time expected, because so much seemed to have been obtained, are very little used. I found an excellent farmer in Scotland, who applied the former with great success to his potatoes, and I have found farmers in England, whose experience seems to prove the excellent effects of both upon wheat; but the fact that they have generally fallen into disuse indicates, whether well founded or not, a strong distrust of their efficacy. One of their acknowledged effects, when applied to wheat, was very much to increase the stalk, without proportionately increasing the grain. The adulterations in these articles have been, I cannot say extraordinary, but flagrant and enormous.

3. SOOT. — Soot is applied, sometimes mixed in compost, at the rate of about forty bushels per acre, and should be applied early in the season. For potatoes, about half that quantity is used, and is deposited in the drill with the seed. With wheat, it is sown broadcast with clover and grass-seed, the ground being first harrowed. It is sometimes sown alone, broadcast, upon grass, and always with advantage. Its effect, however, upon the cereal crops is, to increase the stalk without a correspondent increase of the grain. As it is proved not to diminish the grain, this is to be considered a great point gained.

In an experiment made in the Lothians, by one of the best farmers in the kingdom, he gave me the following as the result: —

A piece of land, manured at the rate of eighty bushels of soot per Scotch acre, costing threepence per bushel, the product was 7040 pounds of hay per Scotch acre.

A second piece, manured in the same way, gave at the rate of 6671 pounds of hay per Scotch acre.

A third piece, without any top-dressing, produced at the rate of 5280 pounds per Scotch acre.

The milkmen object to feeding cows upon land dressed with soot, and to using the hay from such land, from its giving a bad taste to the milk. This may be mere prejudice. I give the fact of their objections, without vouching for their correctness.

4. **Woollen Rags.** — Woollen rags, the clippings of woollen cloth obtained from the factories under the name of *shoddy*, and wool dust, and woollen refuse of every description, make a most valuable manure. Indeed, none ranks higher in value. Besides its own intrinsic efficacy, it becomes mixed or strongly impregnated with oil, used in the processes of manufacturing. Its effects are not immediate, and therefore it is not to be considered as a forcing manure, but they are very durable; and when spread upon grass land, its efficacy is great and permanent. It is deemed, in the highest degree, rich in all the elements of vegetation. It is considered extremely valuable as an application to hop-grounds. The hop-growers in Surrey informed me that it was to be preferred to any other manure. It is deemed best to mix it very copiously with earth or mould; and in this way it should be repeatedly shovelled over, in order to assist its decomposition.

Mr. Hannam, in his excellent little treatise upon waste manures, states the case of a farmer, who, on applying eight tons of shoddy compost per acre, obtained nine tons of hay, in a small hilly field, which before never gave him four tons. It is transported in large sacks, and is a regular article of merchandise.

5. **Lime.** — The value of lime as a manure, if so it may be called, is still, with many farmers, questionable. I found an eminent farmer in Ayrshire, who considered its only value to be as a mechanical divider of the soil; and in respect to another

farmer in Scotland, who, as far as my observation and the character he holds in the county avail, as an intelligent and practical farmer has no superior in the kingdom, he stated to me that he had applied lime to his land liberally, for a quarter of a century, and never saw from it any benefit whatever. On the other hand, the innumerable instances in which it has been obviously beneficial, and where the improvement of the land can be traced to no other cause, compel one to conclude, in reference to its failures, that there must be something in the soil, or in the mode or circumstances of its application, not yet understood. Innumerable instances are found where it has been efficacious at the first application, but its repeated applications have been pernicious. I have already referred to a remarkable fact, that it seems most efficacious upon limestone and chalk soils. My readers shall have the benefit of the opinions of one of the most enlightened chemists, which I subjoin in a note.*

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* Professor Lyon Playfair, in a manuscript lecture with which he kindly favored me, thus speaks: —

"When a chemist in his laboratory wishes to liberate the potash or silica from a soil which he is analyzing, he mixes it with lime and heats them together. By this means he renders soluble, in acids or in water, all that was insoluble before. The farmer performs exactly the same operation as the chemist, when he limes his land. He liberates, by this means, the silica, the potash, and the phosphates, from the soil, and enables them to administer to the wants of vegetation. But by the operation he has furnished no equivalent for that removed by the crops; and therefore it must infallibly happen, that the continuance of the system is merely a continuance of a rapid system of exhausting the soil. A rich clay, abounding in potash, may long survive the treatment, but is as certainly going on to exhaustion as a granary of corn, out of which you take every day a certain amount of grain, and merely put in its place the key with which you opened the granary door. The lime is the key merely by which you opened the magazine of food contained in the soil.

"I speak of it now in the principal way in which it is used; but it not infrequently happens, that it may itself supply an absent constituent of the soil, especially in cases such as clover and grasses, which experience much benefit from a top-dressing of this article. I do not say that the former use of lime is illegitimate, because clays often contain potash enough to last for thousands of years, if nothing more than that ingredient were required; but, at the same time, the lime aids the plants in removing sulphates, phosphates, and other ingredients, which may be required for the purposes of their organism, without restoring what is abstracted. I have frequently found, in the examination of some limestones, lauded for their superior excellence, that their action seemed to be due to the presence of some adventitious ingredient, such as magnesia, which could have been supplied more efficiently by other means.

"There is no manure more beneficially used, or more disgracefully abused, than

6. SEA-SAND. — In some parts of Ireland and England, near the sea-coast, very great quantities of sea-dredge or sand are used, probably very much of the same character as the muscle-bed, much used in some parts of New England, and other maritime parts of the United States.

In Ireland, principally on the western and northern coasts, immense quantities of this dredging are obtained; and the number of one-horse carts, especially near Cork, which I found engaged in the transportation of it, was remarkable. Two kinds of it are obtained, one full of shells, with their living tenants, and consequently abounding in animal matter. "The silicious sand usually amounts to from thirty to sixty per cent; the shells to from twenty to fifty, and, beside carbonate, yield some phosphate of lime and magnesia. There is, generally, from three to six per cent. animal matter, which yields nitrogen by its decomposition; and from five to ten per cent. of salt water, which holds in solution common salt, and other ingredients of sea-water." *

There is another variety of sand found in certain places on the western coast of Ireland, mixed with a substance resembling

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lime. In its principal action, it has no right to be called a manure, for a manure consists in the restoration of ingredients taken from the soil. But lime affords a key to rob the soil anew, so easily applied that we often find a farmer, who works slovenly, content himself with the application of lime, and by its means obtain the same results — accompanied, however, by a destruction of property — that he would by the drainage of the land, and by a proper system of rotation. Hence, we find it often substituted for the drain; for the disintegration, which the air should effect in a drained field, is obtained by lime in one undrained. But the system, in the latter case, is a ruinous one to the landlord, and even to the tenant, if he remain on the soil; and the cause is obvious, when you consider that he applies the lime without any knowledge of the quantity which should be used; and not following it up by a proper rotation, first to take up the liberated potash, and then the liberated silica and phosphates, a large part of the valuable ingredients of the soil is washed away without any benefit to it.

"I will merely refer to one part of the practice, with regard to the application of lime, because it will confirm still further, that its principal action is what I have described. A favorite mode of applying lime is to mix it, while hot, with earth, and after it has slacked itself, to spread the mixture on the field. By using the lime in this state, you produce a powerful effect in liberating the alkalies of the earth with which it was mixed, so that, when you spread it upon the field, you, in fact, spread with it a stock of nutriment in immediate readiness for the plant."

I hope it will not be deemed presumptuous in me, to say that these remarks are extremely rational, sensible, and to the point. The subject, however, is not relieved of all its difficulties.

* Kane's Resources of Ireland.

coral, but which naturalists determine to be of vegetable origin, and which is rich in nitrogenous ingredients. This coral contains, likewise, phosphoric acid, and is greatly esteemed as a manure. These various sands are full of comminuted shells, and very rich in animal matter, either living or dead. They are applied at the rate of ninety bushels, or even double that quantity of bushels, to the acre. "To the large proportion of phosphate of lime contained in the crustaceous remains, and the nitrogenized matters of the fish, much of its importance, doubtless, is due." The farmers in the neighborhood of Cork come ten and twelve miles to obtain it; and "it is dredged in the river from depths varying from ten to thirty feet." This, certainly, speaks strongly in favor of its value.

In Cornwall, England, vast amounts of sand are found near the sea-shore, and are carried into the country. In examining this sand, which is obtained in inexhaustible quantities near parts of the coast, it appeared, in an extraordinary degree, to abound in broken shells. In analytical examination of the sands from different localities, they have been found to abound in carbonate of lime, varying from forty-four to ninety-four per cent. A company has been formed for calcining this sand, which serves to make it more soluble, and renders its action upon the soil more speedy. It is called the *Cornwall patent manure;* and from the advertisements of the company, it might be inferred that it was exactly suited to all sorts of crops and all kinds of soils. Its beneficial efficacy in many cases cannot be doubted.

I have referred thus particularly to these manures, that the farmers living in the maritime parts of the United States might be induced to look after resources of fertilizing their lands, within their reach, which may have hitherto escaped their observation.

7. SUPER-PHOSPHATE OF LIME. — Bones, broken and ground, have been a long time employed as manure in England, and with wonderful efficacy. Indeed, the extraordinary improvements in some parts of the country have been wholly ascribed to the application of bones. It was found, likewise, contrary to all expectations, that bones which had been through the hands of the soap-boiler, and from which all the animal and gelatinous matter had been thus abstracted, and that even bones which had been calcined, were of equal efficacy with those which were ap-

plied in a green state, and fully charged with animal matter. It was also ascertained that bones applied as a manure, beyond a certain point, were not efficacious in proportion to the quantity applied; and that sixty bushels of bones to an acre, produced no more beneficial effect than sixteen or twenty. Here experience and inquiry were confounded, and here science came triumphantly to their aid.

Upon examination, it was ascertained that what gave the efficacy to bones was the phosphorus contained in them, connected with an acid. It was not ascertained that the animal portion of the bones was of no importance; but it was slower in its effects, in ameliorating the soil, than the inorganic portion of the bones; and that what was mainly important, in the application of bones, was to supply this inorganic portion in a form that it should speedily be taken up. In an ordinary state, this phosphorus was combined with lime, in such proportions that it was not easily dissolved; but, Professor Liebig, to whom agricultural science is so greatly indebted, discovered that, by the application of sulphuric acid to the bones, a portion of this lime would be abstracted, and go into another form; and a salt would be left containing a much larger proportion of phosphorus, — and so called the *super-phosphate of lime,* — which was soluble in water, and would be at once taken up by the plant.

"Phosphate of lime is a substance very difficult of solution; and thus, in a very dry season, the effects of bones are slight and imperfect. Super-phosphate of lime, on the other hand, is extremely soluble, so much so that the vitriolized bones can be entirely dissolved or suspended in water, and thus applied. This at once explains the cause of the valuable properties of the preparation. The bones in their natural state are extremely indigestible; the acid cooks them — converts them into a species of soup, which can readily be eaten and digested by the young turnips. The adamantine fetters, with which the various elements composing bones are bound so compactly together, are by means of this new agent burst asunder — the compact is broken, and each constituent element is left to pursue its own course, and exercise its own natural affinities." *

The effects of this preparation of the bones has answered every expectation; and where before sixteen and twenty bushels of bones were applied to an acre, in the growth particularly of turnips, four bushels, prepared with sulphuric acid, are found now to be even more effectual. The advantages of such a preparation are very great, — first, in stimulating and forwarding the growth of the plant; next, in the cheapness of the application; and next, in its so forcing the plant, as soon to place it beyond the reach of the fly, which never attacks it after the third leaf is formed.

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* Spooner's Prize Essay. Journal of the Royal Agricultural Society, vol. vii. p. 1

The best mode of preparing the manure has been matter of various experiments, and deserves inquiry from the acrid nature of the acid employed — the oil of vitriol. Mr. Pusey advises, to erect a heap of fine mould, and, forming a basin or crater in the centre, to place the amount of bones to be dissolved in it, and to apply gradually an amount of sulphuric acid equal to half the weight of the bones, which, after a short time, will completely dissolve them; and then, shovelling and mixing the mould together, the manure will all be in a condition to be distributed by a machine in the drills prepared for sowing the turnip seed.

Mr. Tennant, of Shields, one of the best farmers in Scotland, puts twenty-five bushels of bones into three old iron boilers, and next pours in two bottles of acid, containing one hundred and seventy pounds each, and adds eighteen gallons of water to each boiler. In a day or two, they empty the contents of the boilers into two cart-loads of light mould, with which it is thoroughly intermixed; and, being turned over three or four times, after seven or eight weeks the compost becomes dry and mealy, and can be spread by the hand.

Mr. Spooner advises, to place the bones in a hogshead, and pour the acid upon them at the rate of one third of the weight of the bones in acid, that is, to one hundred and eighty pounds of bones sixty pounds of acid; and, after it becomes sufficiently dissolved, to mix it with ashes, and apply it in that form. He recommends, likewise, that, first of all, the acid should be mixed with one fourth of its weight of water, or perhaps half as much water as acid, which will raise it to the temperature of 300° Fahr., and will much assist the dissolving process. Too much care cannot be taken to guard against the effects of the acid upon the clothes or skin of the operator.

The beneficial effects of this application are now beyond question. Mr. Spooner cites a case in which two bushels of vitriolized bones, with ashes, gave as good a crop as sixty bushels of bones unprepared. To Swede turnips it seems more congenial and efficient than to white turnips. Where the crop of turnips is of so much importance as here, this discovery is of immense consequence. Whether it will be equally beneficial to other crops, — to wheat or grain crops, — is to be decided by further trials. The experiments reported by one farmer, in reference to a crop of carrots the second year after its application, and to a field sown with barley one year after its application, showed most decidedly, so far, its permanent beneficial influences.

There are other manures used here, which I shall find it more convenient to notice in another part of my work, and which, therefore, I now pass over. Some experiments, however, have been made in Cornwall, with top-dressing land with straw, which I shall refer to, as at least highly curious; and which deserve notice, as possible to lead to most important practical results. They rest upon highly respectable authority. The subject has been frequently referred to in the public papers, but a detailed statement has been given by the secretary of the Cornwall Experimental Club, and published in a late Journal of the Royal Agricultural Society, from which I shall abridge the account.

8. FIBROUS COVERING, OR GURNEYISM. — Mr. G. Gurney observed that, "if a bush or other fibrous matter were left lying in a field of grass, the vegetation beneath it would soon be observed to be finer or fresher than that around it. This was a fact known to every one, but the agency by which this increase of growth was brought about, evidently involving some great and important but unknown principle, had never been investigated. Flags, rushes, straw, bushes, or, in short, any fibrous covering, would produce a similar effect. Reeds, or wheaten straw, applied over grass, at the rate of about a load to a load and a half per acre, would, in a short time, increase the quantity of grass to an incredible extent. The various grasses under it would be found to be healthy, and rapidly passing through the stages to maturity, some growing, some flowering, some seeding. Part of a field of grass placed under this operation for one month had increased in weight, over the remaining portion left uncov-

ered, at the rate of nearly three to one. The green grass from the part untouched, cut at the end of the month, weighed two thousand two hundred and seven pounds per acre; that of the portion placed under the operation weighed five thousand eight hundred and seventy pounds per acre. The grass was weighed as it came from the scythe. During this period, there was not a drop of rain; and guano, nitrate of soda, lime, shell-sand, wood-ashes, and other manures, tried against it, possibly from the drought, produced, during this period, no very visible action. In this experiment, the fibrous covering was laid on the 15th of April, and the grass cut and weighed the 30th of May. Half of a hay-field was covered on the 2d of May; and a month after, I had cut and weighed, respectively, the portions of the field covered and uncovered, and found that the one weighed three thousand four hundred and sixty pounds per acre, whilst the other weighed only nine hundred and seventy pounds. As to the length of the grasses in the respective pieces, the trefoil in one case measured three and one half inches, whilst in the other it only measured an inch; clover six inches, in the other one and one half." He found, on making the two samples of grass into hay, that the proportionate loss of weight was the same in each parcel, and the difference would be, that in the one case he should get three tons to an acre, and in the other only one. Another most important circumstance in the case was, that when "a certain quantity of stall dung would double the quantity of grass in a given time, when laid on in the usual way, that it would increase it six times, when properly treated with fibrous covering."

These are certainly very curious experiments, and they have been repeated successfully by various individuals. "For an individual to satisfy himself, a bundle of straw, say forty pounds, strewed lightly over two or three roods of growing grass, would in a very short time show the effect, when raked off. In the experiments made, all gave uniform results, when conducted fairly. Some used too much covering, but *generally too little.* All these experiments showed that the action was general; that the difference in increase of growth, in a given time, was in proportion to the natural fertility of the soil."

"The practical instructions for the use of fibrous covering are few, but essential to profitable results. Straw of wheat, oats, or rushes, is to be lightly and evenly laid over growing grass, in the proportion of about a ton to a ton and a half per acre. At the end of a fortnight, it must be raked up in heaps like haycocks, the grass eaten off by cattle, and the covering again relaid. This is necessary in the growing season, otherwise the herbage will grow through, by which the action will cease; the grass will also become entangled with the covering. If the land is good, the grass may generally be eaten off by cattle before the covering is relaid; if not, at the end of the next fortnight (more or less depending on the richness of the land, the season, and the weather,) it should be done, and the covering relaid again; and repeated at about these periods through the season. If straw be the material used, it will last through the whole summer. In the autumn it is the practice to rake it off when dry, carry it away, and stack it for winter litter. Ground under the action of fibrous covering, we find from our returns, will keep three times the quantity of cattle as ground not so treated. This experience seems in keeping with our experiments on weight and measure, of the produce thus obtained."

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CXI. — GENERAL REFLECTIONS.

I have deemed it proper to lay these various results, resting as they do upon the most respectable authority, before my readers, to whose knowledge they might not otherwise come. If they have no other beneficial effect, they will stimulate inquiry, and prompt to other experiments. The philosophy of these results is as yet in obscurity. The facts in art and science which are continually disclosing themselves to our investigations are most extraordinary and wonderful, and show that we are yet only in the infancy of knowledge. The glimmerings of the early dawn will presently advance to meridian splendor. It is the province of science to investigate the causes of things; this is the work of the human mind; and how can it be more worthily or reverently employed?

I have been charged, more than once in the progress of these reports, with a want of respect for science. I regret if I have given — unwittingly it must have been — any grounds for such a charge. Nothing can be more foreign from the truth. Science, however small my claims to any affinity with her, I love and honor. But mere theory I distrust; self-conceit, which is often harmless, amuses me; unfounded pretensions I hold at their true value; and low and interested quackery I despise. What is science? Not merely the knowledge of books; not merely a familiarity with the technical rules of any art; not mere hypothesis and conjecture, however subtle and profound. But the observation and the accumulation of facts; the following them out in all their relations and bearings; and the tracing, as far as human sagacity can go, all the circumstances and influences, of which they appear to follow as the necessary consequences and results. This is the work of mind wherever mind is found. This proficiency will be most essentially assisted by the knowledge of facts already established and ascertained; by artificial processes and appliances already invented and familiar to the learned. But let us not consider these investigations as the exclusive business and monopoly of the schools. What I want to see is the universal mind awake. I want that men should every where be induced to open their minds to the beautiful and sublime creation, in the centre of which God has placed them, and seek to understand more of it and of themselves. I want that the man who follows the plough, when he opens the bosom of the bountiful and wonder-working earth, should read lessons of divine wisdom written upon its teeming furrows. I want the sower when he scatters his quickening seed, and sees those diminutive grains which he throws about him rising from the earth in forms of matchless beauty, gay with flowers, and at last rich in fruits, and pouring into his lap, as the compensation of his toil, the bread which is to sustain and make life happy, humbly but importunately to inquire, How is this miracle effected? I want the farmer, when he sees his reeking heap of refuse, now offensive and loathsome to the sense, when cast upon the earth, returning to bless him in the richest products of health, and comfort, and life, to follow out, as far as his sagacity can explore, these subtle and marvellous operations of a beneficent providence. I want men should work with their minds as well as their bodies; and I wish that the penalties of indolence and neglect, in the one case, were as severe as in the other. All the practical operations of husbandry furnish ample materials for inquiry and reflection; and inquisitive and reflecting minds, constantly engaged in them, have some peculiar advantages in the study of them, over philosophers exclusively confined to their closets and their laboratories. There is every encouragement to exertion presented even to the most humble. One of the most distinguished ornaments of the school of English chemistry — a man whose attainments would do honor to any country and any age — was devoted, in early life, to a purely mechanical trade, and, by the determined energies of his own mind, has made his way, by universal acclamation, to the proud preëminence which he occupies.* Some of the greatest discoveries in the arts and in science have been made by men of comparatively unassisted genius. I should be too happy, if I could feel that my humble labors had, even in the smallest degree, contributed to induce men to respect their own minds; to lead the laboring portion of the community, while they are working with their hands, to be as active in working with their understandings; and to become ambitious to bring from their own personal inquiry and experience their contributions, however small, to the great and rapidly accumulating mass of human knowledge. So far from contemning science, I reverence it with a species of idolatry — an idolatry, I trust, pardonable, for it is only a form of homage to the great Source and Centre of all intelligence. In the mind of man, enlarged and improved by science, I recognize the proper foundation of moral as well as of intellectual greatness; and I adore with humble gratitude the reflection — very partial and limited indeed it is — of that wisdom and intelligence, which created, guide, arrange, fill, and bless an eternal and boundless universe.

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* Professor Faraday.

Davis

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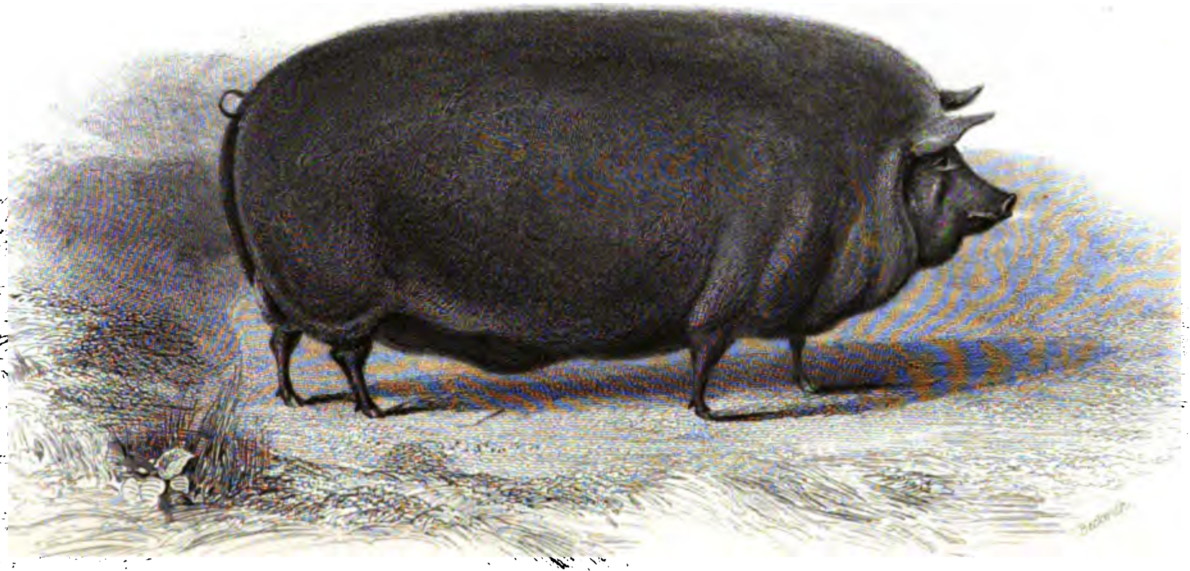

Becker sc.

EUROPEAN AGRICULTURE

AND

RURAL ECONOMY.

NINTH AND TENTH REPORTS.

CXII. FRENCH AGRICULTURE.

The agriculture of France is its great and commanding interest. Its manufactures and commerce are considerable; but its manufactures are mainly concerned in the fabrication, and its commerce in the transportation and exchange, of the products of its own soil. I should have no difficulty in giving the statistical returns of the agriculture of France, but this comes only in a limited degree within my province; and a long table of mere numbers would convey little instruction to my readers. It is of great advantage to France, however, that it procures these returns regularly; and thus, as in the late scarcity of grain and in the failure of the potato crop, enabled the government to provide early, with a humane foresight, against the sufferings which were likely to follow. It is sufficient to say that France has nearly thirty-six millions of inhabitants; and that in ordinary seasons she is able, to a great extent, to feed her own people from her own soil.

CXIII. SOIL AND ASPECT.

The agriculture of a country of necessity corresponds to its climate, soil, and aspect. Besides these physical conditions, it depends upon many circumstances of a political or moral character, and others which may be termed accidental. The territory of France, stretching through nearly eight degrees of latitude, is susceptible of a great variety of cultivation. On the eastern side it feels the cold influences of a range of mountains covered with perpetual snow; on its western side its climate is softened by the vicinity of the broad Atlantic; its northern portions gather humidity from the ocean which bounds it; its southern portions enjoy the sunny influences of an early spring and an almost tropical summer, and of the vapours which rise from that most beautiful of all waters, the Mediterranean, which laves its shores. Its territory is traversed in various directions by several magnificent rivers, the Rhine, the Rhone, the Loire, the Garonne, the Seine; and many minor tributaries, which, if they have not the magnitude of many of the rivers of the western world, afford nevertheless great facilities for inland navigation and transportation; and, at the same time, present on their banks a large extent of alluvial land of the most productive quality.

While the soil of these alluvial lands is most excellent, the soil of the high grounds, as far as it has come under my observation, is of an inferior quality. It is in general strongly calcareous, with the lime or chalk forming almost the entire surface. In dry weather, such lands suffer from the drought, and in wet weather nothing can be more unpleasant to work. Large portions of land likewise are found composed almost wholly of a yellow ochry sand or gravel, mixed at the same time with an aluminous substance, and apparently highly charged with iron, which constitutes a soil very unfriendly to vegetation. Of soils purely aluminous or clayey I have met with few; but there are many of a mixed character, with a loam of considerable thickness on the surface. These are capable of great improvement and productiveness. In some parts of the country, lime and gypsum (sulphate of lime) are abundant; and marl of an unctuous and enriching quality is found in many places.

CXIV. CROPS.

The common crops of France are wheat, rye, barley, oats, beans, and potatoes; but its peculiar crops are, beets for sugar, grapes for wine, and silk. Leguminous crops or esculent vegetables, excepting to a comparatively small amount, for human food, are little cultivated; oats and barley, it seemed to me, only to a limited extent; buckwheat, in the poorer parts of the country, in a small measure; and although the southern portions of France, or more than one-half of the kingdom, would produce Indian corn, it does not appear to be largely cultivated, and its value seems imperfectly appreciated. Hay, or grass for hay, cannot be said to be largely cultivated; but there are extensive meadows, which are left in permanent grass. Of the grasses cultivated for feeding, lucerne (if it may be called a grass) and sainfoin occupy the first place. The former, when cut green, forms the principal food of the stock during the summer, and when dried makes also an excellent fodder. Vetches do not appear to be extensively cultivated, the preference being decidedly given to lucerne. Beans and lentiles are cultivated in some districts. Hemp, tobacco, and flax, are likewise grown; but they cannot be considered as prominent crops. Cabbages are sometimes largely cultivated for stock; turnips rarely; and few fields of ruta-baga of any great extent, have ever met my eye. I have seen large crops of colza and rape, but they do not predominate. It must be understood that I make these observations with great diffidence. France is a large territory: different portions of it, in all their habits, differ much from other portions. It would require years to give a thorough and perfect account of its husbandry, instead of a brief and cursory examination, which is all that my limits admit of.

CXV. THE FORESTS OF FRANCE.

In travelling through France one is constantly impressed with the immense tracts of land which are in forest. The forest connected with the palace at Fontainbleau, only about fifty miles from Paris, is said to contain 35,000 acres; the forest connected with the palace of Chambord, 20,000 acres. There are other forests in France of great extent, some of them being portions of the national domain, and many of them the property of individual proprietors. They are not, however, kept merely for show, or luxury, or sport. The heath or common lands, in France, which remain open and unproductive, are returned as 19,499,180 acres, or about one-seventh part of the whole surface of the kingdom. The fuel generally used in France is wood or charcoal. There are, it is said, large deposits of mineral coal in France; but they are not extensively worked, or are not easily accessible, though their value is beginning to be appreciated. Wood, therefore, is grown for fuel, and comes to market by means of the great rivers and canals in the form of wood or coal; so that these forests are regularly and gradually cut off for timber or fuel, and either re-planted or suffered to grow again from the old stumps. The law permits the proprietors to cut off their wood only once in eighteen years; and this under the control of a government inspector, who requires that it should be cut clean, leaving only such trees as may be valuable for ship-timber or for other purposes, which the government claims a right to take for its own uses at an equitable price. Under these excellent arrangements the supply of fuel is constantly kept good, and the price of wood has scarcely varied for a quarter of a century. In the cities, and in many parts of France, wood is always sold by the pound; and it is curious in Paris to see the immense arks of charcoal and wood which come down the Seine, and piles of wood in the city, covering acres of ground, and on a level with the tops of the highest houses. The value of the timber in these immense forests is likewise great. Although throughout France the principal and almost universal material for building is stone, yet much timber and boards are wanted for floors and roofs, and various purposes; and many large proprietors think that they cannot make a better provision for their children than by planting forests, or preserving and cherishing such as they already have.

CXVI. THE FRENCH PEASANTRY.

Excepting with the great farmers, where there are small buildings for the residence of the permanent labourers ordinarily in the court-yard, or immediate neighbourhood of the great house, the peasants generally live in the villages, and sometimes go long distances to their work. They rise early, and among their first duties are those of religion; their first visit being, in most cases, to the village church, which is open at all hours. I have often met them there in the morning, when it was scarcely light enough to see the way; and I have found crowds of them in the churches at night, after their return from labour, when, with only one or two lamps burning over the altar in the church, it has been so dark that the dress of persons could not be distinguished until you came within arm's length of them. It is the beauty of the Catholic religion, that, although it is in a degree social, it is at the same time individual and personal in its character; that although the ceremonials of the worship are of a splendid, and often gorgeous description, yet the worshipper seems regardless of every thing but his own particular part in the service, which he performs silently, and generally with an intensity and an abstractedness which are remarkable; and in churches whose splendour and magnificence it would require a brilliant pen to describe, I have seen labouring men in their frocks, and with their spades upon their shoulders, and market-women with their baskets upon their arms, go into the churches, and after performing their devotions, and evidently with no other object in their thoughts, go away to their labours.

In all parts of Europe the women are as much engaged in the labours of the field as the men, and perform indiscriminately the same kinds of labour. Having been much among the peasantry and the labouring classes both at home and abroad, I must in truth say, that a more civil, cleanly, industrious, frugal, sober, or better dressed people than the French peasantry, for persons in their condition, in the parts of the country which I have visited, and especially the women, I have never known. The civility and courtesy, even of the most humble of them, are very striking. There is neither servility nor insolence among them; their economy is most remarkable; drunkenness is scarcely known; their neatness, even when performing the dirtiest work, is quite exemplary; cheerfulness, and an innocent hilarity, are predominant traits in their character.

The wages of the French peasantry are in general from a franc to a franc and a half per day to a man, that is, ten to fifteen pence, or twenty to thirty cents; and to women about four-fifths of the former sum, or about eight pence or sixteen cents. In this case they ordinarily provide entirely for themselves. In harvest, however, or under extraordinary circumstances, they are provided for in addition to their wages. Coffee and tea are scarcely known among them. They drink no ardent spirits. Their usual drink is an acid wine not so strong as common cider, and this mixed with water; they have meat but rarely; occasionally fish; but their general provision is soup, composed chiefly of vegetables and bread. Bread, both wheat and rye, is with them literally the staff of life. With all this they enjoy a ruddy health; and the women are diligent to a proverb. They seem unwilling to lose a moment's time. I have repeatedly seen them carrying heavy burdens upon their heads, and at the same time knitting as they went along.

CXVII. SIZE OF FARMS, AND DIVISION OF PROPERTY.

The size of farms in France has been a subject of much discussion. The right of primogeniture has ceased to exist there; and since the great revolution, the law has ordained that the land possessed by any one at his death should be equally divided among his children. This did not take place without a hard struggle against it on the part of the great proprietors, nor without many predictions of ruin to the agriculture of France, from the infinite subdivisions which the land was likely to undergo, and the small size to which farms were about to be reduced. The law, however, has been maintained, and, as far as I have been able to observe, with the happiest results to France[1]. It was predicted, that, under such an arrangement, no system of extensive agricultural improvement could be attempted; and that small proprietors being thus multiplied, and the labourers themselves becoming proprietors, the lands of the country were destined to go into the hands of men without capital, too ignorant to understand or learn the best modes of cultivation; and without the power of applying, even if they knew, them.

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[1] In France the total number of taxed landed properties is stated, in 1835, to have been 10,896,682, and these were again divided into 123,360,338 separate pieces of land. It is supposed, however, that of heads of families occupying estates, which combine many of these smaller divisions, and which consequently become merely nominal partitions, there are about 5,000,000. Now, allowing an average of four to a family, it will be seen that there are 20,000,000 of people

These objections are not wholly without force; but as this subject possesses considerable interest for many persons, I hope to be excused for enlarging upon it. It happens with respect to many things which are deemed evils, or from which evil consequences seem likely to result, that there is a compensating or balancing power at work, which, if left free to operate, of itself corrects the irregularities, restores the equilibrium, and prevents the evils apprehended. If all France were to be cut up and divided into pieces of ground of the size of a table-cloth, as from the comments made upon this law by those who know nothing of its actual operation one would suppose was likely soon to be the case, we should expect a state of things extremely adverse to the national prosperity. But it must be remembered, that while the law requires an equal division of the land among his children at the death of a proprietor, it does not require that the land should remain thus divided. The appropriation of it is left optional with those who inherit it; and in this, as in other cases, they will be governed by their interests, their convenience, and other nameless circumstances by which human

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in France directly interested in the property of the soil. The number of proprietors of the soil in England, who hold landed property yielding a rent of 100*l.* sterling per year, is stated, at the same time, at 38,000; and the whole number of proprietors of the soil in England and Wales is rated at 200,000, and in the whole United Kingdom at 600,000. The extent of the United Kingdom is about two-thirds that of France.—Statistique Générale de la France, par Schnitzler, tom. iii. p. 11.

conduct is ordinarily influenced. A father dying and leaving several heirs, sons and daughters, it is scarcely probable that they will all wish to devote themselves to agriculture; and this too when the parts of such property growing out of this division would be, either of them, too small, under any circumstances, for the support of a family. The result is, as we should expect it would be in such case, that some one of the heirs purchases the rights of the others, and the farm remains in its integrity.

What, then, is the advantage of such a law? It is that it leaves this matter, as it should be left, to the choice of the parties concerned; and that it in fact prevents the too great accumulation of landed property in the hands of individuals. There can hardly be a greater evil, in countries where labour is abundant, and population presses hard upon the means of subsistence, than that immense tracts of land, which might be made productive, should be locked up in the hands of individuals who will neither use the land themselves, nor suffer it to be used by others. It seems a violation of natural right, justice, and humanity; and there are many circumstances in the condition of society in the old world, which indicate that it must be modified or abandoned.

One of the first duties of society is to give to every man a perfect security in the enjoyment of the fruits of his own industry; but it is equally the duty of society to secure to every man disposed to labour an opportunity, as far as possible, fully and effectually to exert that industry. The end which governments ordinarily aim at, is the protection of property; and almost all laws, being made by men of property, have this for their great object. But wealth is ordinarily quite able to take care of itself; and the object of government should be to protect poverty, which constantly requires protection. The true wealth of a community is its labour, its productive labour. A man is not the richer for houses which he cannot occupy; lands, which he cannot use; money, that he cannot spend. He might own a continent in the moon, but what would that avail him? He might die of starvation in the vaults of the Bank of England, or in the undisturbed possession of the richest of the mines of Peru. Labour is the great source and instrument of subsistence and wealth. Labour, therefore, honest labour, should be, under all circumstances, the great object of the protection and encouragement of every just government. Laws should be such as to secure to labour, as far as possible, an open field for exertion. Such is the tendency of the laws of France respecting the posthumous division of landed estates. The laws of primogeniture, by which large landed estates go exclusively into the hands of the eldest son, and laws of mortmain, by which lands are for ever appropriated to particular uses, are laws of a different description. The law of primogeniture seems to many persons essentially unjust in the favoritism which it implies, among those who obviously have equal claims upon parental kindness and impartiality. The law of mortmain and perpetual devises, by which extensive landed estates are locked up and appropriated in perpetuity to particular uses, has met with many warm combatants. They ask, and with what reason I shall leave to the judgment of my readers, Was not the land given to man, that from it, by his labour, he might obtain a subsistence, which, in truth, can come from no other source? Now shall any man, or set of men, so monopolise and appropriate this land that it shall not be available to these objects? It would seem that the earth belongs to those who possess it; and that, when a man once quits it for ever, his rights in it should cease; yet society admits the remarkable fact, that men who died centuries ago, shall determine how the land at present shall be used and appropriated; or that it shall not be used nor appropriated at all.

It does not come within my province to enter upon matters of dispute, which, in a period full of questions and inquiries, seem to be assuming importance, and are becoming matters of private and public discussion. I am well aware of the necessity of giving as perfect a security as human society admits of to the rights of property; but these rights, it would seem, should be held in subserviency to a still higher right, and that is, the right to live. That which a man produces by his industry or toil, by his skill or genius, exerted without prejudice to the equal rights of another man, is his own; it is his exclusively, and it should be his in perpetuity; that is, the appropriation of it should be his, and should be uncontrolled excepting so far as to prevent its application to an immoral object, to an object prejudicial to health or life, or to the public peace and welfare. But the appropriation of the soil itself to any object in perpetuity, the shutting it up from use, the prevention of its occupation for purposes of human comfort and subsistence, seems incompatible with those natural rights with which the Creator endowed man when he commanded him to till the earth, that he might from it obtain a subsistence. The laws in many of the states of the United States, when the property of a debtor is seized for the payment of his debts, very properly take care to leave him in the possession of the tools of his trade, that he may still provide for his own, and the subsistence of those dependent on him. A law which would rob him of his tools, —and while the community and his duty to himself and his family require that he should by his labour provide for himself and them, should virtually put it out of his power to exert that industry,—would be of the same character with that which, under any pretence or form, in the midst of hungry and starving thousands, excludes them from the use of that soil from which Heaven designed they should get their bread, and from which only it can be obtained. It is one of the great effects of the revolution which gave independence to the United States, and of the great French Revolution, that it broke up these restrictive laws, and in general left property in land to follow the usual course of other property; and, above all, made it universally attainable.

In the United States, where land is abundant, and where countless millions of acres must remain for countless years unoccupied, laws restraining the monopoly of land are far less necessary; but even in the United States they should have a care to guard against the perpetual appropriation of land for any objects whatever, whether under the plea of pious or of moral uses, as in fact a direct violation of the rights of every generation to judge for itself, and to judge only for itself what shall or shall not be maintained; and secondly, as conferring a power which experience shows is liable to gross and injurious abuses.

A principal objection urged against this subdivision of land is, that it prevents any system of extensive improvement of the soil by the great processes of modern discovery,—draining and subsoiling. This argument has some force; but we may hope that in many cases the owners, seeing their own interests clearly concerned in such improvements, may combine their forces to effect them. In many of these small holdings, likewise, the cultivation being by the spade and not by the plough, the land will be trenched as a substitute for subsoiling, and an equal productiveness secured. Where such improvements are obviously demanded, and they might be too great for individual effort to accomplish, there seems no reason why the government itself should not undertake them, assessing the expense upon the different owners of the land in such forms as would be equitable, and made payable at such periods as would render its discharge easily practicable.

It is objected likewise that these small farmers, having no capital to apply in the cultivation of their lands, and being of a class not likely to be acquainted with modern improvements in husbandry, their agriculture will probably be of an inferior character. These objections must be allowed some weight; but then the holders of these small parcels are acting under the most powerful of all stimulants, that of their own immediate self-interest. They themselves being the owners of the soil, whatever improvements it receives, and whatever crops it produces, must accrue directly to their own benefit. The holding being small, it becomes the more important that it should be forced to the greatest extent, in order to meet their wants. This circumstance will prompt to the greatest exertions in procuring from every available source, and in saving their manure for the enriching of their small farms. Labour and economy thus applied, may be said in themselves to constitute a valuable and active capital.

But in place of speculations let us revert to facts, and inquire how this system has actually worked in France. It has produced a great revolution in the tenure of property; but from the best inquiries I could make among the most intelligent and candid, I found a unanimous and emphatical acknowledgment of its beneficial results. In what may most properly be called the rural districts, that is, a district somewhat remote from large towns and villages, there are found farms in size from one hundred to five hundred, seven hundred, and a thousand acres and upwards; and so it seems likely to remain. The law, though it requires a division of the real estate among the heirs, does not make it compulsory to continue such division. The law in fact does little else in such situations than, so to say, to bring the land into the market, and leave it then to be disposed of according to the circumstances of time and place.

But in cases of partition we may suppose a farm of twelve hundred acres divided among four heirs; they would have farms of a respectable size; divided again it would leave farms of seventy-five acres each, which perhaps may be considered the average size of farms in New England, and exceeding the average size of Flemish farms. Even another division of the same number of parts might take place, and twenty acres would correspond with the size of many of the most productive farms in Belgium. Many persons in arguing against such an arrangement, proceed upon the supposition that the division is to be infinitesimal. But this is absurd; and, as I have already remarked, the evil of too great a subdivision has always a tendency to correct itself, and to stop where it would become positively mischievous. This is found to be the case, as I have remarked, in the strictly rural districts. But a person passing through the environs of large towns and cities will perceive that the division has proceeded very far; the fields often appear like patch-work, and are cut up into very small pieces. This is exactly as it should be. These pieces are owned by small gardeners, who supply the markets with fruit or vegetables, and who, on account of its limited extent, carry their cultivation to a high perfection, and often in the number, variety, and quantity of their crops on these small pieces of ground, astonish one by their success. Very often these pieces of land are owned by persons engaged in severe mechanical trades in the cities, who find health and needful recreation in their cultivation. One thing is quite certain in such cases—that no land thus situated will be left uncultivated; and under the system of minute economy to which it is subjected, will unquestionably be rendered as productive as possible.

If we look at large farms in Great Britain,—I mean farms of hundreds of acres, with the exception of some of the best cultivated districts, such as the Lothians in Scotland, for example, or the counties of Northumberland, Lincoln, and Norfolk, and only some farms in these counties, we shall find that even these are by no means always fully cultivated; and that, either for want of skill, or enterprise, or capital, large portions of them are wholly unproductive. This is far less frequently the case with small farms, for the simple reason that the owners cannot afford to neglect their land, and that the management is much more easy. It is to be added likewise, that in very small holdings of six, or ten, or twenty acres, the great expense of a team, and of costly implements is dispensed with. In some parts of England, though very rarely, but in many parts of the Continent, and especially in Switzerland, the small farmers use their milch-cows for work, thus getting a double advantage from them; and a milch-cow, used tenderly, and treated liberally, may be worked from four to six hours a day without injury to her milk. This saving is a great circumstance. On large arable farms it may be calculated, that from a fourth to a third of the produce must be counted for the support, and equipments, and cost of the teams. The saving of this expense is a great affair; and this is accomplished on small holdings where cows are kept, which pay the expense of their keeping by their labour and their calf; or where, as in many cases, the whole cultivation is performed by human instead of brute labour—by the spade instead of the plough. I believe, therefore, it will be found, that in a fair comparison, the small farms are in fact more productive than the large ones; that they are managed at less comparative expense, and, in proportion, leave more for human consumption.

If thus much may be said of the economical results, still more may be said of the beneficial moral influences of such a system. Of all the influences which operate to promote exertion, industry, and good conduct, none certainly is more powerful than the hope of bettering our condition; and I may add, without undertaking to give a reason for it, as an established truth, that nothing inspires more self-respect, as connected with a feeling of independence, than the possession of property, and especially the possession of a fixed property in house or land. This effect is constantly seen in the labouring classes among the French. They are extremely ambitious of getting a piece of land; and perhaps too much so, after once coming into possession, of extending their possessions.

This stimulates them to industry, and induces the most rigid economy. The subdivision of property or of land in France renders this practicable, which, in other countries, where the right of entail prevails, or where property is held in large masses, and guarded with extreme jealousy, is out of the question. There is a wise foresight likewise in this matter in respect to the security of public order and the peace of the country. The persons of all others least likely to engage in projects of revolution certainly are those whose property must in every case be endangered by such revolution; whose possessions are fixed, and not transferable from one place to another at pleasure. Their estates constitute the strongest pledge of their loyalty and patriotism. The more property is divided in a country, the more equally it is held, or rather, that it should be attainable by all on equal conditions, the greater security is there for the rights of property; the more are concerned in the preservation of the public peace. The humblest agricultural labourer in France may look forward, by industry, sobriety, and economy, to become a proprietor and a holder in fee-simple of some portion of the soil which he cultivates. There is, therefore, the strongest inducement held out to good conduct; and the beneficial influence of this condition of things upon the character of the French peasantry cannot be doubted.

Few things have struck me more forcibly than the difference in the condition of the agricultural population of France and that of Great Britain—a subject to which I have already referred. I have never seen a more healthy, a better-clad, or a happier population, than the French peasantry. Something may be ascribed to their naturally-cheerful temperament, and something to that extraordinary sobriety, which every where in a remarkable degree characterizes the French people; but much more, I think, to the favourable condition in which this law, which renders attainable the possession of a freehold in the soil, places them.

I am extremely averse to making any unfavourable comparisons; and I am quite aware that my judgment may be at fault; but I shall offend no candid mind by the calm expression of my honest opinion. The very poor condition of a large portion of the English agricultural labouring population must be acknowledged. The acquisition of property is, in most cases, all but impossible. The great difficulty, where there is a family, is to subsist; in sickness they have no resource but private charity or parish assistance; and they have in most cases nothing to which they can look forward when the power to labour fails them, but the almshouse.

I believe there is an equal amount of philanthropy, and as strong a sense of justice and humanity among the English, as among any people; but it is not to be expected that in any country where wealth constitutes the great and most enviable distinction, and where, by various circumstances, avarice is stimulated to the highest degree,—that the great mass of the community should be either philanthropic, or humane, or just. Wealth is almost every where, in what is called civilized, and too often miscalled Christian, life, the great instrument of power. Power is a dangerous possession, and always liable to abuse. The only security against this abuse is the division of power; and to give the humbler classes the means of helping themselves.

In Great Britain, as I have already said, the rural labouring classes are placed in circumstances of hardship and disadvantage. It would be ordinarily quite idle for them to aspire to the ownership of land. Philanthropic and benevolent persons in various parts of the country have given them small allotments; though some have endeavoured to limit these allotments to one-eighth of an acre, and many farmers have combined in denouncing the allotment system, and have refused to take leases where the labourers were to be allowed allotments. The beneficial effects of these allotments, both upon the comfort and morals of the labouring classes, have every where been acknowledged; but under the best circumstances, the allotment system can never be a substitute for that by which the ownership of the land is itself attainable.

I will not contest the point that great improvements can only be expected to take place on large estates and with the help of large capital; yet, on estates of a medium size, such as a hundred or even fifty acres; these are, perhaps, more likely to take place than on estates of a much larger size, as being ordinarily more within the reach of most men—the majority of farmers being men of restricted capital. The immense improvements in dyking and embankments, and in redeeming land from the sea, which have been made in Holland, and in Lincolnshire and Cambridgeshire, in England, could only have been effected by the union of large bodies of proprietors. No single fortune is any where competent to such enterprises.

I will not deny that under a system of large farms more produce may be for sale; and, in a commercial view, more money will be made, and larger fortunes accumulated. But I cannot agree that the wealth of a community, held as it ordinarily is held, is the standard of its prosperity. That undoubtedly is the happiest condition of society, where none are over-rich, and none extremely poor; where one is not continually offended by those striking contrasts of enormous wealth and extreme destitution, which some countries present. That condition of society is undoubtedly above all others to be preferred, where the power of bettering our condition, is, as far as possible, equally enjoyed by every man, and certainly not denied to any one; and where every possible encouragement and facility are given to the exertion of this power. It is often a great charity to help our neighbour; but the best and wisest of all forms, in which this charity can be exercised, is that, when a man helps his neighbour to help himself.

CXVIII. MEASURES OF THE GOVERNMENT FOR THE IMPROVEMENT OF AGRICULTURE.

The measures of the government for the advancement of agriculture have much to recommend them, if they are carried out in an intelligent and faithful manner.

1. **Department of Agriculture.**—In the first place, there is a department of agriculture, the secretary or minister of which, being one of the first men in the kingdom, is expected to look after this great interest; to obtain statistical returns of agricultural produce from all parts of the kingdom; to learn what is the condition of the art; what improvements have been made; what improvements are most required; and what is the condition of the agricultural population.

2. **Statistical Returns.**—The statistical returns of the produce of France have been recently completed, and show a work of immense industry and labour. It is obvious that such a work can present only an approach to exactness; but even that is of great value; and it will be found that some facts have been brought out, in respect to the average increase of the crops, which are in the highest degree encouraging. These returns have been obtained by a direct application to well-informed and confidential individuals, in different parts of the country, who have made their returns to the central bureau in Paris. A great variety of subjects have been embraced in them, such as the amount of land in cultivation; the amount of land devoted to different crops; the manure applied; the quantity of seed employed, and the average yield. It extends, likewise, to the number of persons engaged in agriculture, and the number of domestic animals reared or kept in every department, with a great variety of agricultural and commercial information, sub-

sidiary to, and connected with the subject, of a very interesting character, and of equal utility. This magnificent work does the highest honour to the government, and to the persons employed in its execution.

3. Inspectors of Agricultural Districts.—The next provision made by the government is the division of the kingdom into four agricultural districts, to each of which an intelligent and experienced agriculturist is appointed, as inspector or commissioner, whose duty it is to go through his district annually at least, observe carefully its condition, and report it to the government; and at the same time, in his journeyings, communicate every where advice and information, as he may see that they are needed. This is certainly an admirable mode of dispensing knowledge and exciting emulation[1].

4. Importation of Improved Stock.—The government likewise have imported from other countries some of the most valuable animals, such as bulls and stud-horses; and stationed them in different parts of the country, that the farmers may avail themselves of the advantages which they offer for the improvement of their stock. On account of the large demands made by government for horses for the cavalry, this becomes a matter of great importance. Whether the keeping of bulls would not be better left to private enterprise, is a question much debated. That which belongs to the public is seldom cared for like that which belongs to an individual; but the government have met this objection by disposing of their improved animals occasionally at public sales.

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[1] At one time several persons were employed by the government to visit foreign countries for the purpose of seeing their improvements, gathering agricultural information, and bringing home such plants and seeds as were likely to be useful to the country. It is proposed by the provisional government to revive this excellent plan. March, 1848.

5. Agricultural and Veterinary Schools.—France has likewise several agricultural schools, established in different parts of the kingdom, of which I shall presently give an account, designed to furnish a complete scientific and practical education in agriculture. In addition to this they have veterinary schools, where comparative anatomy is thoroughly studied, and the diseases of all the domestic animals most carefully treated. These likewise may be supposed to grow in a great measure out of their army, where the medical treatment of their horses is obviously of great importance.

6. Agricultural Societies and Show.—In various parts of the country agricultural societies are established, and assisted by the government, for the purpose of diffusing information; and these will, in all probability, extend themselves. A society in Paris, composed of some of the first men in the kingdom, meets regularly twice a month for the discussion of agricultural subjects, for the report of improvements, and, at the end of the season, for the bestowal of premiums. An agricultural show was undertaken the last year at Poissy, the Smithfield of France, where some excellent native, and some very good improved stock, though not to a large amount, was exhibited; and here I saw sheep of the very best, and most profitable kind, especially for such a country as the United States, where good mutton, and particularly fine wool, are in demand. These were pure Merinos of a very large size, well-proportioned and fat, and with fleeces of an excellent quality. I have never seen animals of the kind combining more valuable properties. It is intended that these shows, of which this was a first attempt, should be continued annually.

7. An Agricultural Congress.—Previous to this show, an Agricultural Congress, composed of more than 300 gentlemen interested in agriculture, and sent as deputies from

different parts of the country, had been sitting in Paris for a fortnight to discuss practical questions in agriculture, and likewise political questions bearing upon it; which was done with great ability. At Poissy, the Minister of Agriculture distributed premiums of large amount; and every circumstance indicated an active, an increased, and increasing attention to this great subject.

8. CONSERVATORY OF ARTS AND TRADES.—Paris is, in the next place, distinguished by its direct means of scientific instruction. It has what is called a Conservatory of Arts and Trades. This is, properly speaking, a school for the industrial and mechanical classes. Here is a complete collection of models or of examples of agricultural buildings and implements—to say nothing of other arts—not only of those in use in France, but specimens of the best of every description which are used in foreign countries. Here, under accomplished professors, courses of agricultural lectures, or rather of chemistry and mechanics as applied to agriculture, are regularly given, to which access is entirely gratuitous, the professors being supported by the government; so that here is presented to inquisitive minds the best means of learning the application of science to agriculture. Perhaps, in the science which involves the connexion of chemistry with agriculture, no country has made so great advances as France, as the labours of Chaptal, Boussingault, Payen, and other distinguished men decisively show. If agricultural chemistry could make men good farmers, the French should take precedence of all others. How far the facts conform to this supposition I shall leave to others to judge; because I have no wish to put my head into the lion's cage: though I am compelled to say in passing, that the best arable farming which I have ever seen, the cleanest, the most exact, apparently also the most productive and economical, is in countries where there is no science, technically so called, and

implements only of the most ordinary description; I mean Belgium, Holland, and Switzerland. I shall take occasion to remark upon this fact in another place.

9. **Society for the Improvement of Wool.**—Besides the Society of Agriculture, which meets in Paris twice every month, and is the centre of the correspondence of all the agricultural societies of the country, there is likewise a Society for the Improvement of Wool, who twice a year bestow valuable premiums upon persons who have made the greatest advances in the improvement of the fleeces of their flocks. This society has its public exhibitions of wool, and has undoubtedly accomplished much good.

CXIX. PARIS MARKETS.

1. **Corn Market.**—Paris concentrates much within itself that is extremely interesting to an agriculturist. Its markets are in the highest style of convenience, neatness, and abundance. The market for the sale of all kinds of grain is a circular stone building two stories in height, and 126 feet in diameter, surrounded by high galleries for the storage of flour, the unground grain being in the centre on the floor, and covered in by an iron roof of admirable architectural construction. The building is completely fire-proof. The grain is always brought to market in sacks, and the building, it is said, is capable of containing 10,000 sacks. There are to be found here wheat, rye, barley, oats, buckwheat, beans, peas, lentils, and vetches. Bureaus, or small offices, are ranged round the circle on the inside for the factors, or salesmen; and, as in almost every other department of business in France, women are as much employed in the sale of grain as men; and there can be no doubt they manage with admirable skill and address. Sharp trading

seems often the characteristic of the sex; excepting only where the affections are concerned. The Corn Exchange is held here two or three times a week.

2. **Meat Markets.**—The meat markets are of the neatest possible description; but they are scattered about in shops. The beef in Paris, in point of fatness, is much inferior to the English; yet it is of a fair quality. The mutton is likewise very inferior to the English. Some persons complain of the English beef and mutton, especially the Dishley mutton, as being much too fat, and therefore attended with great waste. Veal in France is not killed until it is full six months old, and is of the very finest description. The meat-shops in Paris are shut in by doors of iron grating, so as to admit a free circulation of air at night, with cloths covering the meat to ward off the dust; and they are visited every morning by the police, and undergo a strict examination, so that, if there is any meat of a bad description, or which has remained on hand too long, it is at once condemned and seized. The butchers in Paris are licensed, and laid under heavy bonds to conform to the police regulations; and the meats and other articles brought into Paris are subject to a duty, collected at the barriers, which goes towards the improvements of the city.

3. **Markets for eggs, butter, cheese, vegetables, fruits, poultry, fish, &c.**—The market of the Innocents[1], as it is called, is one of the largest in Paris. This market is to undergo great alterations, and a very large sum is in reserve to build it upon the most extensive and magnificent plan. This market comprises not only the great fish market of Paris, but also the egg market, the butter and cheese markets, the potato market, the onion market, and the

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[1] Being the site of an old convent or nunnery.

general vegetable and fruit markets. The sellers, with scarcely an exception, are women, very sharp, very busy, and of course very talkative. Looking down upon the whole area from the magnificent fountain in the centre, it would be difficult to find a more gay and animated scene. The fountains in Paris are one of its most remarkable features; and no principal market is to be found without its continually-flowing fountain.

The vegetables, butter, eggs, fish, and many other things, are always disposed of at auction early in the morning to the retail dealers. The vegetables in Paris are excellent. Carrots, and turnips, and onions, are not so large as in England and the markets of the United States, because the French deem the large-sized vegetables not so good for eating as the smaller-sized. It is remarkable likewise that there is hardly any season of the year when almost any description of vegetables may not be found in the markets of Paris; and in the middle of December green peas, asparagus, string beans, and strawberries, may be purchased in quantities, which shows the perfection to which the art of gardening is carried among them.

The fruits exposed in the markets of Paris are of a superior quality, pears especially, for which the French have long been celebrated. The St. Michael and the St. Germaine pears, which, in the United States, have almost wholly failed, from having, as has been supposed, completed their period, are here still in perfection, which would seem to contradict this theory, and leave some other cause to be discovered for the extraordinary failure of these excellent fruits. I have not been able to ascertain any thing in respect to the culture of any of these articles, which is not familiarly known to all cultivators.

4. Market for Forage.—I have spoken of the grain market in Paris; it has likewise its hay and forage markets,

where extensive sheds for protection against the weather are furnished. These articles, as in England, are sold in small bundles of a fixed weight. I shall, perhaps, surprise some of my American readers if I inform them, that hay, in small packets or bundles, is often sold in Paris at the groceries. I refer to this fact for an opportunity of making a remark, which, hereafter, if it has not now, will have some importance in the United States; and that is, that where hay, for example, is bought in such small quantities, it is likely to be expended with an extreme economy. No observing American comes from the United States to Europe, without soon becoming convinced, that economy of living is no where so little understood as in his own country; and that for nothing are the Americans more distinguished, than for a reckless waste of the means of subsistence. The refuse of many a family, in the United States, even in moderate circumstances, would often support in comfort a poor family in Europe. When persons buy tea by the ounce, and wood by the pound, and hay by the handful, it is quite obvious that these articles will be expended with far more frugality, than where the store is less limited and seems inexhaustible. While meanness is contemptible, a rigid economy avoiding all waste, is a great virtue. The inhabitants of the United States enjoy an abundance for which they cannot be too grateful; but which is very little understood in Europe, where, with a large portion of the population, including many in the middle condition of life, it is a constant struggle to live, and to bring even their necessary expenditure within their restricted means; and where the constant inquiry is, not what they want, but what can they afford,—not what they will have, but what can they do without.

5. HORSE MARKET.—Paris, besides its grain and cattle markets, has likewise, weekly, its horse market, for the sale

of horses, mules, and asses, where immense numbers of every description are brought, and change hands; and where the morality is probably upon a par with that of the trade in horses in other parts of the world, of the green-spectacle character as exemplified in the Vicar of Wakefield.

6. Flower Markets.—The flower markets are another extraordinary feature in Paris. These are held at all seasons of the year, in three different parts of the city, twice a week, and in the most favourable season comprise a collection of flowers and plants as beautiful as the climate admits of. It is stated, on good authority, that occasionally there are exposed in a day, in Paris, for sale in these different markets, not less than 30,000 pots of flowers, the value of which is estimated at full 9000 dollars, or 1800*l.* sterling. With the strict notions of utility entertained by some persons, such facts may seem scarcely compatible; but, if we may judge that to be useful, which gives us a pure and perfectly innocent pleasure, certainly there is no luxury whatever which should be looked upon with more favour. There are distinct markets, held likewise at proper seasons, for the sale of trees, ornamental and fruit-trees, and flowering shrubs and plants, presenting an extraordinary and beautiful variety.

CXX. ABATTOIRS OR SLAUGHTERING HOUSES.

There are other establishments in Paris which are intimately connected with agriculture; and among these the abattoirs or great slaughtering houses deserve to be considered. There are at least five of these large slaughtering establishments for cattle in Paris, just at the barriers of the city. No cattle are allowed to be driven through the streets of Paris unless it be very late at night, when the streets are empty; and no person is allowed, under any circumstances, to slaughter cattle in the city. These abattoirs are enclosed by high stone walls, excepting at the entrance, where there is a handsome iron paling; and the space covered by each of them embraces some acres. These are magnificent establishments. The enclosure of one of them, for example, and they are all built upon the same model, though not all of equal size, is 645 feet in one direction, and 570 in the other. I shall take the liberty here of borrowing a detailed account of the arrangement of one of them which I have repeatedly visited. In front of it is a small promenade planted with ornamental trees; and the enclosure contains twenty-three piles of building. At the entrance are two pavilions containing the offices of those persons who have the management of the establishment. To the right and left of the central court, 438 feet in length by 291 in breadth, are four immense slaughter houses, separated by a road crossing the enclosure; they are each 141 feet long by 96 broad, and include respectively a flagged court, on each side of which are eight slaughter houses for the use of the butchers, by whom the keys are kept. Each slaughter house is lighted and ventilated from arcades in the front walls. Above are spacious attics for drying the skins and preparing the tallow; and, to preserve coolness, a considerable projection is given to the roofs. Behind these slaughter houses are two ranges of sheds containing sheep-pens, and at the extremities are stables for about 400 oxen. Each of these buildings contains a loft for forage. These masses of building form the sides of the court. At the end is a commodious watering-place and pens for cattle and sheep, besides two detached buildings, each traversed by a broad corridor which communicates with four melting houses, below which are cellars containing coolers. Beyond these, parallel with the outer wall, are two buildings raised on cellars, in which the skins are kept, and near them, in front of the entrance, is a double reservoir for water, 228 feet in length, built in solid masonry, and resting on arches, which form stands for carts. There is also a *Triperie*, or building for washing and boiling tripe and calves' feet.

Cattle and sheep, on coming to Paris, are immediately driven to one of the abattoirs, and there kept at the cost of the butcher. The meat is taken to the shops in the city during the night. The slaughtering at one of the abattoirs, for example, may be estimated at a weekly average of 400 oxen, 300 cows, 600 calves, and 2000 sheep. The establishment is superintended by a resident inspector of police, and gives employment, independently of the butchers and their servants, to eighteen individuals with their families. Houses for the residence of the workmen and managers are within the court-yard, with handsome grass-plats, trees, and a fountain in the centre. This description gives, however, a very imperfect idea of these truly grand, convenient, and useful establishments. The buildings are all of stone, with roofs of brick-tile upon iron rafters, so as to be completely fireproof; and the neatness is such that, excepting in the boiling houses, one is not in the smallest degree offended by any noisome odour. Every part of the animal is taken care of and turned to some use, and there is no waste of any kind whatever. The blood and waste manure are all received into cisterns, to be applied to some useful purpose; and an abundance of water always at command, enables them to keep the slaughtering places, which are neatly paved with flagging-stone, entirely clean. The whole is under the immediate direction of the city government: and there are so many checks, that there is scarcely a chance, as there is no motive, for fraud. The salesman finds his animals slaughtered in the neatest manner, and the proper returns accurately made. Such establishments are most important in their bearing upon public health; and I should most truly rejoice to see them taking the place of those private establishments in the neighbourhood of our large cities, and in England in the large cities themselves, which are odious in all their relations, and which often poison the atmosphere to a great extent. The public inspection of the establishment by disinterested parties prevents the sale of diseased meats, which there cannot be a doubt is carried to a great extent, and with perfect recklessness, in many private establishments in some countries, where they are secure from observation. Such establishments as these abattoirs would be greatly for the satisfaction, if not the advantage, of the farmers of the United States, who, driving or sending their cattle to the market, must now, in most cases, resign them to the purchaser; and, without any opportunity of seeing them either slaughtered or weighed, must rely upon his honesty for a true return of the weight; a reliance not always of the surest kind.

It is curious to remark, in connexion with this subject, the slow progress of improvement, and the obstinacy with which persons adhere to old customs and usages, however objectionable. The abattoirs of Paris have now been established more than thirty years; and yet London, perfectly aware of their eminent advantages, and so distinguished for its social improvements, and claiming a monopoly of what are called the comforts of life, submits to the terrible nuisance of a crowded cattle market in the midst of its thickest population, to and from which cattle are driven at all times of day and night, to the great terror, and often at the peril of life and limb, of the passengers. Slaughter houses are to be found in all parts of the city, even the most fashionable, into which cattle are driven directly through the front doors and passages of handsome residences; the Newgate market is completely underlaid with subterranean slaughter houses of an odious description; the blood, and much of the animal refuse, so valuable in an agricultural point of view, passes into the common sewer, either to check the current and produce disease, or it goes on with other filth to poison the waters of the Thames: and in one of the largest and most populous streets in London, for some distance the side-walk is lined with slaughter houses, where the killing of the animals is open to every passer-by, and where the very gutters, as I have often seen them, are red with blood. The London markets have very imperfect protection against the sale of diseased meats; and diseased animals in Smithfield meet with a quick disposal at a lower price to persons who in various forms disguise the meat, and impose it upon the humbler classes. Indeed, in all that concerns the cleanness, the preparation, and the economy of human food, and the pre-eminent neatness of those who sell as much as of the articles which they sell, the French—I speak particularly of the Parisians—are within my knowledge, excepting only the markets of Philadelphia, without a rival. They are, indeed, scarcely approached. No part of the animal is lost; every part which is capable of being converted into human food, is prepared for use; and even the cold meats, the fragments and remnants of the table, which are sold in the markets to the poor, are always presented in a clean and inoffensive manner[1].

Besides these establishments for the slaughtering of cattle and sheep, there are abattoirs for the slaughtering of swine, distinct from these, but upon the same plan.

I have observed nothing particular in the mode of killing cattle in Paris; their heads are brought to a ring, and they are then stunned with an axe, and the throat is cut. I do not know that a mode of killing producing less suffering has as yet been devised; but I am not without hope that even this mode may be improved on. When we consider the vast amount of animal life which the wants and luxuries of man require to be daily taken, humanity is greatly concerned in the diminution of the suffering attending it. Since Divine Providence has recently revealed to man an inexpensive method of suspending sensibility, so that the most painful surgical operations are endured without suffering, and even without consciousness; and the first discovery has been succeeded by one as effectual, and even more simple and of more easy application, I see reason to hope that it may be applied to the lower classes of animals, to save them, in the cases referred to, the pangs of death; and thus an immense amount of animal suffering be prevented. If there are any who regard the subject with indifference, and look upon the suggestion as ridiculous or useless, I can only say that with such persons I have no sympathy whatever.

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[1] The Londoners, it seems, are just waking up to the utility and importance of establishing abattoirs in the neighbourhood of the city; though strange to say, they have suffered an admirable establishment of this kind at Islington, conveniently situated and excellently arranged, to lie useless and to go to decay.

Since the above was written, a project for the removal of the Smithfield Market has been defeated, and a public dinner been held to celebrate the triumph of the successful party. It ought to have been given in one of the subterranean slaughter houses of Newgate Market.

They have a practice in Paris which I have not seen any where else. When the skinning of the animal is commenced, a large bellows is inserted under the skin, by which it is inflated, and becomes much more easily separated from the flesh than by the ordinary process of skinning with the knife.

CXXI. THE FILTH OF PARIS.

There remains one establishment to be spoken of, directly connected with, and of great importance to, agriculture, as well as to comfort and health; but which, having no other than a disagreeable interest to many of my readers, I forewarn them at once to pass it over; though a French writer humorously observes, that "a book written upon assafœtida is in itself no more offensive than a book written upon roses." In some respects, the habits of the French, both in their houses and the streets, are execrable and abominable. No familiarity in any degree reconciles a delicate mind to them; and exposures are frequently witnessed in the public streets, which are absolutely brutal, and which in England (not in Scotland), and in most parts of the United States, would be regarded as indictable. Yet Paris, in other respects, is an eminently clean city; and even in these matters is evidently improving, and is, with the exception of Milan, Turin, and Genoa, vastly in advance of the Italian cities. Rome, Florence, and Naples can hardly be considered other than as three great public necessaries, where the most sacred places are scarcely free from nuisances, which shock all decency and reverence; and the old town of Edinburgh, and Glasgow, and Dundee, may fairly claim an unenviable position in the same rank.

This subject considered in a philosophical and practical view, is of the first importance. It would be altogether a false, in truth, a mere affectation of delicacy, to hesitate to treat it as its importance demands. In all the arrangements of Divine Providence, nothing strikes the reflecting mind with more force than the beautiful circle of mutual dependence and reciprocity in which every thing proceeds; so that the humble elements perform their part, and the most elevated and brilliant can do no more; and the part of the former is as essential to the common well-being as that of the latter.

Look at a heap of manure, composed of every offensive substance which can be congregated together, reeking with detestable odours, and presenting a mixed mass of objects utterly disgusting to the touch, the smell, and the sight. Yet this is the food of the vegetable world; containing all the elements of richness, nourishment, health, and beauty. All these, the plants know how to separate, to analyze, to digest, and appropriate, and with a skill distancing the sagacity of science, they will return it purified and sublimated in bread, and wine, and oil; in flowers of exquisite colouring and beauty; in perfumes the most odorous which nature's toilette can furnish; in fruits luscious to the taste; and, above all, in products indispensable to life, and full of health and strength. The farmer, standing in his barn-yard, knee-deep in its offensive accumulations, may proudly say, "Here is the source of my wealth; that which has fed my cattle shall now feed my crops; that which has given fatness to my flocks shall now give fatness to my fields." A mysterious power is ever operating in every department of nature; suffering nothing to fail of its use; "gathering up the fragments, that nothing be lost;" and providing for the various wants of the infinitely varied forms of life to which existence has been given, and from whom, if the Creator should, for one second, withdraw his guardian care, the whole must instantly perish.

The refuse of a city may be considered as of at least five different kinds; first, the ordinary refuse of a house, such as fragments of vegetables, remains of food, bones, rags, and a thousand miscellaneous and nameless substances; second, the remains of fuel, such as ashes and soot; third, the refuse of different trades, of workers in leather, workers in bone, workers in horn, soap-boilers, glue manufacturers, workers in hair and in wool, sugar refineries, and the innumerable other trades always to be found in the busy hive of a city; fourthly, the dung of the domestic animals, cows and horses; and lastly, human ordure or night-soil. I shall say little of some other substances which have been used for purposes of manure; but it is well known that many grave-yards have been ransacked for the purpose of gathering up their mouldering relics, and that many hundreds of tons of human bones have been transported from the field of Waterloo to England for the purpose of enriching the cultivation. It cannot be denied in this case to be a more rational, humane, and, I will add, Christian use, than that to which they were put in the bloody arena, where they were first deposited.

In Paris every species of refuse is husbanded in the most careful manner. No refuse is allowed to be thrown into the streets after a very early hour in the morning, nor until after ten o'clock at night. This refuse consists of what may be called the house-dirt, and is laid in heaps in front of the houses near the gutters. A very numerous class of people, called chiffonniers, consisting of as many women as men, with deep baskets on their backs, and a small stick with a hook at the end, carefully turn over every one of these heaps, selecting from them every article of bone, leather, iron, paper, and glass, which are thrown at once into their baskets, and being carried to their places of general deposit, are there again examined and assorted, and appropriated to any specific application for which they may be suited. These persons appear like a most degraded class; they inhabit particular quarters of the city, and the interior of their habitations is such as might be expected from their occupation. The profession descends in families from father to son, and from mother to daughter. They are a most industrious race of people; and many of them may be seen, even at midnight, with their lanterns, taking advantage of the first pickings, and anticipating the labours of the coming morning; and with the earliest dawn they are sure to be found at their tasks. No article of food escapes them; and they call the street their mother, because she often thus literally gives them bread. Though their occupation is necessarily dirty, yet they are almost always comfortably clad, and are never ragged. They never beg, and disdain to be considered objects of charity. They are licensed by the city authorities, for which some trifling sum is paid, and for which they must be recommended for their sobriety and good conduct. They have their particular districts assigned them, and are very careful to prevent all foreign intrusion.

The chiffonniers having done their work, next come the sweepers and collectors of dirt. Every inhabitant of Paris is required, under a penalty, to have the side-walk in front of his place of business or residence carefully swept every morning. The sweepers of the streets in Paris are almost universally women, who, with long twig or birch-brooms, sweep the streets thoroughly, and all the accumulations are taken in carts to be transported to the great places of deposit. The women assist as much in loading the carts as the men. These women appear to work extremely hard, carrying always a long broom in their hands, and a shovel fastened to their backs, to be used as occasion may require. The gutters in Paris are washed out every morning by fountains which are placed in every street, and what these sweepers are not able to collect for the carts, they are careful to sweep into the drains leading into the common sewers. I have looked at these people and at the chiffonniers often with great interest; and, filthy and disgusting as their occupation necessarily is, I have always felt in my heart a sincere respect for persons who, poor as they are, would be ashamed to beg; and who, by the severest and most useful labour, are proud to obtain for themselves and their families, though a very humble, an honest living. All this refuse is transported to places appropriated for its deposit, where it remains until it is decomposed, and is then sold to the farmers for manure.

CXXII. NIGHT-SOIL.—POUDRETTE.

The disposal of the night-soil in Paris is a different affair, and occupies a large class of persons. In the crowded parts of London and Paris such an appurtenance to a house as an open yard is not always to be looked for, and the houses are built in immediate contact with each other. The accommodations for the family are necessarily within doors. In England there are water-closets closing with a trap, and of most exemplary neatness. In Paris, with some exceptions, they are not water-closets, but mere cabinets; and from habitual neglect, which seems too generally to prevail among the middle and lower classes, filling the house with a detestable odour. In many of the houses in the Scotch cities, and houses not always of an inferior description, will it be believed, there are no accommodations of this sort within or without doors. The refuse of the family used to be thrown from the windows at night, not always to the perfect safety of the unwary passenger, and is now commonly carried into the gutters in front of the houses, after ten o'clock at night, to be taken up by the night-carts in passing. Can it be surprising that fever and disease annually remove a large portion of the population of such places?

In London this refuse passes off into the common sewer[1], and from thence mixes with the water of the Thames. It is calculated that this refuse, which may be said to be worse than lost, would be sufficient to manure annually more than a million acres of land, if it could be applied. I have in another place referred to an association formed in London, with an enormous capital, for the purpose of applying the liquid portions of it; but the progress as yet made does not warrant any public report. The passage of this fecal matter into the sewers does not remove all offence; for in London the odour from the traps or ventilators of the sewers, which are necessarily frequent, is in warm weather disagreeable and odious. Though the habits of the English are eminently cleanly, yet, judging from the sanitary reports, the condition of things in some of the poorer districts of London, and in several of their manufacturing towns, is most objectionable and degrading[1]. Paris, in some respects, then, has the advantage of London, and, indeed, of every city which I have been in, excepting the cities of Holland and Belgium—in that all this fecal matter is saved, and certainly with less offence in its removal than could have been supposed possible.

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[1] The extent of these sewers may be judged of from the fact, that one day in London I saw a man emerging from an opening in Hay Street, near Berkeley Square, with a bunch of candles in his hand, who told me he had travelled seven miles under ground. The sewers are about five feet in height, and of a proportional width, being the segment of an oval with the bottom cut off, thus O. This probably was an exaggeration; but it must require a good deal of courage to have ventured even half that distance alone, although it is an undoubted fact, that there are many persons in the habit of daily exploring the sewers, where they sometimes find prizes of value. What an employment!

In general it is removed by what is called the atmospheric process. The cart is placed at the door in the street; a long leather hose is extended from the vault to the cart; and, the air being exhausted, the fecal matter in a semi-fluid state passes directly into the cart. The whole affair is managed, not absolutely without offence—for that at present seems impossible—but certainly without any offence which is avoidable. The men bring their working-dresses with them, so as never to appear in the streets otherwise than in decent attire. The vehicle in which this fecal matter is conveyed, is a very large, tight cask, or sometimes several tight casks: the horses, harnesses, and the whole equipment are of a neat and perfect description; and in most cases would never be detected by a stranger, if either he were not informed of their uses, or did not read the inscription of the objects to which they are devoted on some part of the vehicle. In no case is any offensive matter left in the streets, or permitted to escape from the carts, until it arrives at its place of deposit.

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[1] The worst parts of Paris and the worst habits of Paris are, however, entirely distanced by some parts of London, eminently cleanly as it is in many other parts. Hear what the philanthropic Lord Ashley has recently said in his place in parliament:—

"He should read a description of a court which he had witnessed himself. It was in such places that a large mass of the community dwelt. In one of these courts there were three privies to 300 persons; in another there were two to 200 people. This was a statement made by a medical man. In a place where these public privies existed, scenes of the most shocking character were of daily occurrence. It would scarcely be believed, that these public privies often stood opposite the doors of the houses; modesty and decency were almost altogether impossible."—*Times* of June 7, 1848.

The "cabinets d'aisance sans odeur," which are to be found in many parts of Paris, and which are always kept in the most cleanly condition, but which are often spoken of with sneers by strangers visiting Paris, are to be highly commended as useful and important public accommodations. An eminent medical gentleman once assured me, "that a very large portion of the worst maladies which he had to deal with, arose out of improper neglect in this matter, growing out of inconvenient arrangements or a false delicacy, which should be got rid of."

The carts arrive at their destination before, or as soon as day-light. This place is near one of the barriers of the city. The fecal matter is here suffered to run out upon an extensive piece of ground, flattened and made hard like the bottom of a brick-yard. Here it remains until the liquid portion runs off into an artificial basin, from whence as much as is wanted is taken for the purpose of extracting the sal-ammoniac. The rest escapes into the canal in the neighbourhood. The solid matter becoming dry is then broken up, turned over, re-broken; and this process goes on until it becomes so dry as to be easily reduced to powder, when it is laid up in heaps of which immense masses are accumulated. It is thus almost entirely deprived of odour, and may be handled without offence. In this condition it is sold to the farmers, who remove it either in open carts, or in bags or casks. I cannot say that this place (which occupies several acres of ground), or its neighbourhood, is without offence; but it is inhabited chiefly by persons who get their living by the operation; and to whom, therefore, the offence is not so great. After the first drying, when it forms a thick and hard crust, it is broken up by the plough, and afterwards by the harrow; and this operation is necessarily several times repeated. In the end it passes through a thorough sifting. As many women are employed here as men; and the labourers are principally of the lower order of Germans, whose industry and acquisitiveness are usually remarkable. A great many children are likewise employed; and the search after prizes of value is always animated. As to the healthiness of the occupation, its early processes are undoubtedly perilous both to health and life; and many a poor fellow perishes in the vaults, into which they are sometimes compelled to descend; but I found an overseer on the spot, who said he had been constantly employed there for eighteen years, and had never suffered even a day's illness.

The municipal arrangements in Paris seem to me, in various matters, commendable. For effecting the process spoken of, so important and indispensable to health, comfort, and even life, there are three contractors, men of large capital, who take the whole enterprize of cleansing the city in this matter upon themselves. The city is divided into four districts. The contractors are laid under heavy bonds to provide horses, carts, and workmen; never to remit the work excepting one night in seven, Sunday night, and they are paid so much by the cubic foot, by the owner of the house whose vaults they cleanse. They do not begin their work before eleven o'clock at night, and they must leave the city before day-light. The men are divided into parties of five; and each man has his particular office, and is known among them by a distinct name. The corporal or overseer, constituting one of the five, directs the whole operation, and gives his aid as occasion may require. The man, whose duty it is to descend into the vault, always does it at the risk of his life from suffocation. They are liable also to suffer from an inflammation of the eyes, which makes them blind for several days, in which they frequently weep blood, and which is attended with extreme suffering. The whole number of persons employed in these services in Paris, exceeds two hundred. They constitute a people by themselves, and the employment goes down from father to son. Their wages are from twenty to twenty-five francs a week, or from four to five dollars, or one pound sterling. A notice is given at the proper office, by the owner of a tenement, that his vault requires to be emptied, and the service is immediately attended to.

I have gone thus at large into these homely details for several reasons; first, for their bearing upon agriculture; for, perhaps, no manure is so valuable. We send ship after ship into the Pacific Ocean, to bring home that for which we have a substitute equal, if not superior in efficacy, at our own doors. Secondly, because the information how the removal of this matter is performed in such a city as Paris, may be of use in other cities, where it is generally left to private enterprize, with very imperfect apparatus and preparations; and is often slovenly and offensively performed. I confess that, in the third place, I have been moved by some moral reasons, because I would lose no favourable opportunity of calling the attention of the richer and more favoured classes in society, to the condition of their more humble brethren in many departments of human industry, upon the results of whose labour they live; and who peril their lives, and pass their days and nights in the most humble, the most severe, and often the most odious and disgusting services, to secure the health and comfort of those elevated above them; and receive in the form of compensation for labours so perilous and offensive, that which serves only as a bare subsistence. It is said, that the wives and children of the men who perform the most dangerous part of these services, when their husbands and fathers leave home at night, show the same anxiety for their safe return, as if they were leaving upon some perilous voyage by sea.

Various methods have been tried for the purpose of disinfecting this substance; but, either from their inefficacy or the difficulty and expense of procuring them, are seldom used. Quick-lime thrown into the vaults is said to destroy the best parts of the manure; but, by many persons, however, it is greatly approved. Charcoal-dust, burnt tan, peat-ashes, the mud from the bottom of rivers or ditches burnt or dried in ovens, have all been used, as it is reported, with success; and may be recommended not only as disinfectants, but as useful additions.

The Parisian arrangements are far from being perfect. In London at present every thing of this sort is lost. In Paris only the solid portion of the excrementitious matter is saved for manure, whereas there is no doubt that the urine is of far greater comparative value than the solid portions. Various attempts have been made to save this in such a form that it might be easily transported; and in London, manures are sold under the name of urates, which are only urine combined with plaster or gypsum: but the quantity of urine taken up in such cases is so small, compared with the weight or bulk of the article, that in this respect it is considered of little efficacy or value. Chemistry would perform an immense service for agriculture, if it could discover a means of combining this substance in some portable form, and in which its efficacy might be preserved. One of the circumstances constituting the great value of guano, and of the dung of birds, separate from the particular food on which they live, is that their excrements being voided under one form only, the element of urea is inseparably combined with the other matters.

I shall not trouble my readers at present further on this subject; in which I can only say I have been anxious to give no offence even to the most delicate mind, and must claim their indulgence if I have not succeeded. I shall now proceed to other topics.

CXXIII. AGRICULTURAL EDUCATION.

The subject of agricultural education has received much attention in France; that attention is increasing, and new institutions are growing up, to which the Government promptly lend their aid. The subject is of so much importance, that I deem it proper to give an enlarged account of the leading establishments for this object which have come under my notice.

1. School at Grignon.—The principal establishment for agricultural education is at Grignon, about twenty miles from Paris. It consists of an estate of 474 hectares, or about 1200 acres, with a large dwelling-house upon it,—formerly, I believe, a royal seat,—and other necessary buildings, which have been erected since its endowment. It was ceded by the French king, Charles X., for a term of forty years, to a society of gentlemen specially interested in agriculture, who have the management of the institution, and, by private subscription, have supplied the funds for conducting it[1]. The government are represented in the management of the estate. They provide all the instruction, by paying the salaries of the professors and superintendent; and they support some pupils. The pecuniary results for the last few years have been favourable; and all profits go to the support of free pupils, or to increasing and extending the benefits of the institution, which is capable of accommodating seventy pupils. The term of residence is fixed at two years, though it will be seen, from the course of instruction adopted, a much longer time is requisite to acquire a thorough education in the branches prescribed.

The institution at Grignon is designed to supply instruction both in the science and practice of agriculture, and the constitution and arrangement of the school seem admirably adapted to this end. The students in general are from that class in life who depend upon their own exertions for a livelihood. This is as it should be. In the United States we have no other class, and, from the present arrangements of property, are not likely to have. Long may this wise and happy arrangement continue! In a great portion of Europe, a large part of the community are little else than beasts of burden. As long as they live, they must carry upon their backs those who do not choose to maintain themselves. It is a pity they could not put their burden down, and make them "go themselves." Their doom, however, is fixed; and with the present distribution of political power, and the present moss-covered institutions respecting property, there is little chance of an alteration. In England and in France a class exists of which at present, in the free portion of the United States, we know nothing; and it may be some time before they are required. These are the persons who manage the estates of large proprietors; who in England are called bailiffs or stewards; in France, agricultural engineers. Grignon may be said to be particularly designed to educate this useful class. At the same time, there are among the pupils several who seek this education for the management of their own estates; and these agricultural engineers are themselves, without doubt, hoping presently to become proprietors. In the south of France, land is held generally under what is called the *mettayer* system, or what is known in the United States as taking land upon shares. After certain deductions, the half of the produce is returned to the proprietor as the rent of the land. In either case such education must be highly valuable. In the case of a tenant, that he may be able to obtain the best return from the land, and, in the case of the proprietor, that he may know what to require, and how properly to direct the management of his estate.

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[1] The sum raised by private subscription amounted to 300,000 francs, or about 60,000 dollars, or 12,000*l.* sterling. The rents paid to the government for the estate are the same as were paid by the farmers who previously held it. The substantial or permanent improvements upon the estate are estimated by a commissioner once in five years, and are to go, at the end of the lease, in acquittal of the rent. The money subscribed by individuals was given to the institution. On this capital, employed on the farm, an interest of sixteen per cent. has been realized, which goes, as above stated, to the benefit of the institution.

The term of residence at Grignon is fixed at two years; but the pupil remains three months after his studies are completed, in order to digest and draw up the entire management of an estate, and describe its details in every department.

The students are divided into classes denominated internals and externals, or resident and non-resident. The former reside entirely in the house, where they are lodged and boarded, and pay about 800 francs, or 32 pounds, or 160 dollars, per year. The externals, or non-residents, provide for themselves, or lodge at the houses of the neighbouring farmers, and pay a very small amount for their instruction. This arrangement is particularly designed to benefit poor scholars. Both classes are equally subject to the general discipline and rules of the institution; and are alike engaged in the same works and studies.

There are lectures every day in the week. At the commencement of each lecture, the professor examines the pupils on the subject of the preceding lecture; and they are required often to take notes, and present a written report of the lecture. Besides the professors, there are two monitors, who have been educated at the school, who labour with the pupils in the fields. They are expected, and it is their duty, to question the pupils on the subjects which have been treated in the lectures; to show their application; to illustrate what may have been obscure; and, in short, to leave nothing unexplained which is liable to misunderstanding or error. There are two public examinations annually, in which the scholars are subjected to a rigorous questioning in what they have been taught. If, at the end of two years, their conduct has been approved, and their examination is met successfully, they receive a diploma from the institution.

They are not only employed in the general work of the farm, but particular portions of land are assigned to individuals, which they manage as they please, and cultivate with their own hands; they pay the rent and expenses of manure and team, and receive the product or its value from the institution. Certain of them are appointed in turn to take care of the different departments of the farm for a length of time—such as the hog establishment, the sheep establishment, the cattle, the horses, the implements, &c. &c. They have likewise adopted a practice, which seems much to be commended—that of employing workmen, shepherds, cow-herds, &c., from foreign countries; as, for example, from Belgium and Switzerland, that they may in this way become acquainted with the best practices in those countries.

The time is thus divided and arranged among them:—they rise at four o'clock in summer, and at half-past four in winter. They go immediately into the stables to assist in the feeding, cleaning, and harnessing of the teams, and the general care of the live stock, according to their respective assignments. At half-past five they take a light breakfast; at six o'clock they go into the halls of study, and here they remain until eleven o'clock; at half-past six they attend a lecture, or course of instruction, which occupies them until eight o'clock; at half-past eight they are occupied in reading or in making notes of the lectures which they have heard, and the monitors before spoken of are present to render them any assistance required; at half-past nine o'clock there is another lecture or course of instruction for both sections, which occupies them until eleven, when they take their second or principal breakfast. From noon until five o'clock, the pupils are occupied in labour or practical operations. The professors, from time to time, take a section, and employ them in land-surveying, in drawing plans, and in levellings; others are occupied in mineralogical or in botanical excursions, or in inspecting the management of forest lands; others are occupied by their teacher in the practical management of farming implements, in the management of teams in the field, in sowing, and other general operations of husbandry, in a field devoted to these purposes; and a section, to the number of twelve, are every day employed in the direct labours of the farm, in ploughing, digging, harrowing, &c. &c. They work in company with the best labourers, that they may observe and learn their modes of executing their work. They are required to be attentive to every operation that is performed; and to present a full report of each day's work to the director-general.

At half-past five in winter, and at six in summer, they take their dinner. At seven o'clock in the evening they go again into the halls of study. From seven to half-past eight o'clock there is another course of instruction, or a repetition of what they have had before. Until nine o'clock they are occupied in their journals, or in making notes of their lectures. At nine o'clock the sleeping rooms are lighted, and they retire for the night.

There are several distinct professorships. The Professor of Practical Agriculture gives two courses; the one written, the other oral; and, like the lecture of a clinical professor at the bed-side, it is given in the fields. This professor understands not only how a thing should be done, but how to do it; and he can put his hand to every form of agricultural labour, such as ploughing, harrowing, sowing, managing the teams, feeding the animals, handling every instrument of agriculture, buying, selling, &c. In the words of his commission, his object is at the same time to form the eye and the hand; to teach his pupil how to learn; to command, to direct, and to execute. To this end it was necessary to form a complete agricultural organization for practice, independent of the exercises attached to the departments of the other professors.

The farm is composed of

Arable land, about	670 acres.
Land in wood and plantations . . .	365 „
Irrigated meadows	35 „

Gardens, including vegetable, botanical, fruit garden, orchards, mulberry plantations, osiers, and nurseries .	28 acres.
Ponds and water-courses	15 „
Roads and lands in pasture	50 „
Occupied by buildings	6 „

The animals on the farm include

Animals of draught or labour of different kinds	18
Oxen for fatting	20
Cows of different ages and races, and different crosses	100
Sheep, embracing the different kinds .	1100
Swine establishment	100

There are likewise on the establishment workshops or manufactories, if so they may be called,—

For the making of agricultural instruments;

A threshing-house and machine for grain;

A dairy room for the manufacture of different kinds of cheese and of butter;

A magnanerie, or establishment for silk-worms;

A stercorary for the manufacture of compost manures.

To all these various departments the attention of the students is closely called, and they are required to take some part in the labours connected with them.

Besides the farm belonging to the establishment, there is a field of one hundred acres devoted exclusively to the pupils, and principally to the culture of plants not grown on the farm. Here they make experiments in different preparations of the soil, and with different manures.

Every week two scholars, one of the second and one of the first year, are appointed to attend particularly to the general condition of the farm. Their business is to examine constantly the whole establishment; the works that are going on in every department; to look after the woods and the plantations; the gardens; the horses; the fatting cattle; the dairy; the sheep-fold; the swine; and the hospital; and to attend to the correspondence and the visitors. This service lasts a fortnight, and there is a change every week, taking care always that there shall be one scholar of the first and one of the second year associated. They attend to all the labours on the farm, and to all the communications between the principal director and inspectors and the labourers. In the veterinary or hospital department of the establishment, they assist the surgeon in all his visits and operations; take notes of his prescriptions; make up and attend to the administration of his medicines; and observe particularly the sanitary condition of the stables and buildings, where the live stock, sick or well, are kept.

On Saturday evening, each scholar, to whom this duty has been assigned, makes to his fellow-pupils a full verbal report of what has been done. This report is transcribed into a journal designed for that purpose; and thus a continued history of the entire management of the farm is kept up. The whole school is divided into sections or classes of twelve each: six of two and six of one year's standing; and these sections are constantly under the direction of the Professor of Practical Agriculture.

As the establishment at Grignon may be considered a model agricultural establishment, it may be useful to go more into detail in regard to the course of instruction pursued here.

Once a week there is an exercise, which embraces every thing relating to the management of the teams and the implements.

First, for example, in the different modes of executing any work, and using the utensils employed. The harness, the collar, the traces, and how attached, the shaft-horse or the cattle attached to the load, and the adjustment of the load to their backs; the yoke, the single yoke, the double yoke; the pack-saddle; the harnessing of a saddle-horse; the team for ploughing; the team for harrowing; the team for drawing loads; the team for waggons and for carriages with all their appurtenances: every one of these matters is to be practically understood, as well as the whole management of the team in action.

In ploughing, the turning the furrow, its inclination, its breadth and depth; the laying out of fields; the management of large and small fields; how to make the first furrow, and to finish the last furrow; to lay the land flat, to break it up in clods; to plough it at a certain angle, to lay the land in curved furrows: these are all considered, and make part of the instruction given. The preparation, equipment, and use of every agricultural implement—such as ploughs, harrows, rollers, scarifiers, cultivators, sowing machines, trenching machines; the practice of sowing, the different modes of sowing, whether broadcast, by dibble, or in drills; the application of manure both as to time, mode, quantity, and preparation, and the composting of manures, are matters of inquiry and practice.

The cutting of grasses; the making of hay, and the construction of stacks; the harvesting of grain, by the scythe or by the sickle; appendages to the scythe, called commonly the cradle; and the grinding of scythes; the making of sheaves, and of shocks, or stacks; and the loading and the stowing away of grain, are matters to be understood.

A practical attention is required to every form of service on the farm; in the cow-house; the horse-stables; the fatting-stalls; the sheep-fold; the styes; the poultry-yard; the threshing-floor; the stercorary; and the store-houses for the produce of the farm of every description. The duties in this case embrace not merely the observation of how these things are done, but the actual doing of them until an expertness is acquired.

Leaving the practical department, we come now to the course of studies to be pursued.

For admission into the institution some previous education is demanded, and the candidate is subjected to an examination before the principal and one of the professors.

First, he is required to present an essay upon some subject assigned to him, that his knowledge of the French language and grammar may be ascertained.

It is necessary, next, that he should be well grounded in the four great rules of arithmetic; in fractions, vulgar, and decimal; in the extraction of the roots; in the rules of proportion and progression; and in the system of measures adopted in France.

In geometry, he must be well acquainted with the general principles of straight lines and circles, and their various combinations; and with the general measurement of plane surfaces.

In natural philosophy, he must understand the general properties of bodies; and be acquainted with the uses of the barometer and thermometer.

Candidates for admission must bring with them certificates of good character and manners, and must be at least eighteen years old. They are rigidly held to an attendance upon all the courses of instruction at the institution; and have leave of absence only on the application of their parents or guardians.

The studies of the first year are begun with a course of mathematics. Geometry and trigonometry are made a particular subject of attention; embracing the study of straight lines, and circular or curved lines on the same plan; the admeasurement of surfaces; the use of the compass; the recording of measurements; the delineation of measurements; the surveying of open fields, of woods, of marshes, of ponds or lakes; comparison of ancient land measures with those in present use; the use of the square, the chain, and the compass; the elevation of plans; the construction of scales, and the ordinary divisions of landed properties.

The study of various plans in any form; solid measure; conic sections, their principal properties, and their practical application; the theory and practice of levelling; the method of projections and their application; cubic measure of different solids, of hewn stones, of rough stones; the measurement of loose or broken stones, of sand, of lands excavated, of ground filled in, of stacks, and of heaps of manure; the cubic measure of trees standing, and of felled trees, of beams, and every kind of carpenter's work, of firewood, of walls, arches, and ditches or dikes; the ascertaining of the capacity of carriages, waggons, carts, wheel-barrows, pails, troughs, barrels and casks, basins or ponds, and different vessels in use, and of granaries and barns, and the determination of the weights of bodies. To all this is added a full course of trigonometry. They are accustomed likewise to the familiar use of the scale, of the square, of the compass, and of the compasses for delineation, and are often occupied in superficial and in profile drawing.

The next course of instruction embraces embankments, the force of earths and liquids, or their pressure, at rest or in motion.

The materials employed in masonry; their uses and application in building—embracing stones, bricks, lime, sand, mortars, cements, plaster; and all the various modes of building.

The laying of walls for foundations; the erection of walls; the supports requisite; and the construction of passages, enclosures, and arches; the different kinds of woods, their absolute and relative strength; their duration, and the modes of preserving them; every kind of carpenter's work; the construction of floors, staircases, scaffoldings, and exterior supports; the constructions of roofs, in timber, with thatch, rushes, shingles, tiles, slates, zinc, or bitumen; the paving of roads, the formation of barn-floors, with clay or composition of bituminous substances which form a hard and enduring surface, are subjects of inquiry.

Next comes instruction in the blacksmith's shop, in the use of the forge, and the other implements of the trade; and in the various applications of iron and steel, of copper, lead, and zinc.

They are instructed, likewise, in the manufacture and use of leather and cordage; and in the various details of painting and glazing. The prices or cost likewise of all these different processes, are, as far as practicable, ascertained; and the modes of estimating such work are explained.

The next course embraces the elements of natural philosophy; and this includes chemistry, geology, and mineralogy.

First, the general properties of bodies, their divisibility, elasticity, and porosity or absorbent powers; and the special influence of this last circumstance upon the character of an arable soil.

The following are all subjects of study: bodies in the mass; the weight of bodies; means of determining the density of bodies and their specific gravity; the physical properties of the air; of atmospheric pressure; and of the construction and use of the barometer.

The study of hydrostatics; the pressure of liquids in their reservoirs, and against dikes and embankments; hydraulics; capillary attraction; the use of siphons and pumps.

The study of heat in all its various phenomena. Its effects upon solid and liquid bodies, and the changes which it makes in their condition; the phenomena of fusion, ebullition, and evaporation; of vapours; of the hygrometer or measurer of moisture, and the utility of the instrument; the conducting powers of bodies; of metals in particular; of free or radiating heat; application of heat to furnaces or kilns; laws of cold applied to bodies; power of emitting and of absorbing cold; measure of heat; means of determining the mean temperature of any place; influence of heat and cold upon vegetation; means of preserving certain vegetables from frost; construction and use of the thermometer.

Meteorology. Explication of the phenomena of dew; of white frosts; of clouds; of rain; of snow; their various influences upon harvest, and the whole subject of climate.

Study of light. Progress of light in space; laws of its reflection; laws of its refraction; action of light upon vegetation. The subject of vision. The polarization of light; the explication of the rainbow, and other phenomena of light; the prism.

Study of electricity. Conductors of electricity; distribution of the electric fluid in nature; power of the electric rods or points; electricity developed by the contact of bodies; of galvanic piles; their construction and uses. Atmospheric electricity; its origin; the formation of thunder clouds; action of electricity upon vegetation; of lightning; of thunder; of hail.

Chemistry. Simple bodies; compound bodies; difference between combination and mixture; atomical attraction; cohesion; affinity; what is intended by chemical agents. Explanation of the chemical nomenclature, and of chemical terms.

The study of simple bodies. Of oxygen; its properties; its action upon vegetation, and upon animal life. Nitrogen, sulphur, chlorine, carbon, hydrogen; their action upon vegetable and animal substances; their uses in veterinary medicine, and their influence upon vegetation.

The study of compound substances. Chemistry as applied to air and water; their importance in agriculture; their influence upon the action and life of plants and animals; the acids,—the sulphuric, the nitric, the carbonic, the chloric; the alkalis,—lime, soda, potassium, ammonia; their application in various forms. The salts in chemistry, and their various applications and uses; their importance as constituent parts of the soil, or as improvements.

The subject of marls and of earths, and of various substances deemed favourable to vegetation. Under the direction of the Professor of Chemistry, the students are taught to make analyses of different soils and marls.

To this is added a course of Mineralogy and Geology. This embraces the general properties of minerals; the physical, chemical, and mechanical character of mineral substances the most common.

The study of the distinctive properties and situation of those mineral substances which are most extended over the globe, and which are the most in use; such, especially, as the carbonate of lime; comprehending stones for building, for the making of roads and walls, lime-stones, marbles, sulphate of lime, or plaster of Paris; and all the variety of mineral substances ordinarily found, and of use in agriculture or the arts.

A course of Geology follows this, embracing all the leading features of the science, with a special reference to all substances or conditions of the soil connected with agricultural improvement.

In this case, the professor makes frequent excursions with the pupils, that they may become familiarly acquainted with the subjects treated of in the lectures, and see them in their proper localities; so that the great truths of geological science may be illustrated by direct and personal observation.

Next follows a course of instruction in horticulture, or gardening.

Of the soil; the surface and the subsoil, and practical considerations relative to their culture and products.

Of the climate; the temperature, the aspect and local condition of the land in reference to the products cultivated; the amelioration of the soil, and the substances to be used for that object, with the modes of their application.

The various horticultural operations, and implements employed; and manner in which they are to be executed. The employment of water in irrigation; modes of enclosing by ditches or walls; walls for the training of trees; trellises and palings; and of protections against the wind.

The different modes of multiplication; sowing, engrafting by cuttings and by layers, and practical illustrations of these different processes. The culture of seed-bearing or grain-producing plants; the choice of them; their planting and management; the harvesting and preservation of the crops.

Under this head comes the kitchen-garden, and the choice of the best esculent vegetables for consumption; the nursery, and the complete management of trees from their first planting; the fruit-garden, considered in all its details; and the flower-garden.

The general results of gardening; the employment of hand, or spade-labour; the care, preservation, and consumption of the products, and their sale. The gardens at Grignon are upon a scale sufficient to supply all practical demonstrations.

The next division embraces the botanical garden. Here the whole science of botany is treated in its principles, and their practical application. The study of vegetable organization, with a full account of the prevailing systems and nomenclature of botany, and the classification of plants. Vegetable physiology, in all its branches, and vegetable anatomy; comparison of plants in their native and cultivated states; influence of cultivation in developing and improving plants; the propagation of plants in their natural condition, or by artificial means; the subject of rotation, or change of crops.

The practical application of these botanical instructions; and especially in the examination of plants or vegetables which may be useful in an economical view.

The garden of the establishment embraces what is called a school of trees; a school of plants for economical and commercial purposes; and a school of plants for common use.

These are all carefully classed and distinguished by their proper names. The pupils are accustomed to be led into the gardens by the professor, that his instructions may be fully exemplified and confirmed.

The next branch of science taught at the school is veterinary surgery and medicine. This embraces a course of anatomy and animal physiology. It comprehends a full description of all the animal organs; and demonstrations are given from subjects, destroyed or obtained for that purpose. The functions of the different organs are likewise described; the organs of digestion, respiration, circulation, and the organs connected with the continuance of the species.

Every part of the animal, external and internal, is shown, its name given, its uses explained; its situation in relation to the other organs; the good points, the faults or defects in an animal; the peculiarities of different races of animals, with the modes of discriminating among them.

The choice of animals intended for different services,—as in horses, for example, whether for the saddle, the race, the chase, the carriage, the road, the waggon, or the plough. Next, the treatment of the diseases of animals; the medicines in use; their preparation, and the mode of applying or employing them.

The next subject of instruction embraces a complete system of keeping farm accounts and journals, with the various books and forms necessary to every department.

From this the pupil proceeds to what is called rural legislation, embracing an account of all the laws which affect agricultural property or concerns.

I shall give a specimen of some of the topics treated of in this department.

The civil rights and duties of a French citizen, and the constitution of France.

Property, moveable or immoveable, or, as denominated with us, personal and real; of the divisions of property; of its use and its obligations.

Of commons; of laws relating to forests; of the rights of fishing in rivers; and of hunting.

The laws relating to rural police; to public health; to public security; to contagious or epidemic diseases.

The rights of passage of men or animals over the land of another; if any, and what.

Of crimes. Theft in the fields; breaking or destruction of the instruments of agriculture; throwing open enclosures; destruction or removal of bounds. Laying waste the crops by walking over them; inundation of fields by the stoppage of streams, or the erection of mills. Injury or breaking of public roads and bridges. Poisoning, killing, or wounding animals.

The duties of country magistrates; guards or justices of peace. Of courts of law.

Of contracts, general and specific. Contracts of sale and prohibitory conditions. Of leases of different sorts. Of hiring labour; of the obligations of masters and servants. Of corporations, and the laws applicable to agricultural associations.

Of deeds, mortgages, bills of exchange, commissions, and powers of agency and attorney; insurance against fire, hail, and other hazards. Of the proof of obligations; written proof; oral testimony; presumptive evidence; of oaths. Of legal proceedings; of the seizure of property real or personal, and of bail.

The instruction proceeds under various courses, and I have so far given but a limited account of its comprehensiveness, and the variety of subjects which it embraces.

The study of the different kinds of soil, and of manures, with all their applications, and the improvements aimed at, take in a wide field. Under the head of soils there are the argillaceous, the calcareous, the siliceous, turf-lands, heath-lands, volcanic soils, the various subsoils, loam, and humus.

Under the head of manures, come the excrements of animals, all fœcal matter, poudrette, urine; the excrements of fowls; guano; noir animalisée; the refuse of sugar-refineries; the relics of animals; oil-cakes; the refuse of maltings; tanners'-bark; bones, hair, and horn; aquatic plants; green-dressings.

The application likewise of sand, clay, marl, lime, plaster, wood-ashes, turf-ashes, soot, salt; the waste of various manufactures; mud and street dirt.

The plants cultivated for bread; wheat, rye, barley, oats, buck-wheat, millet, rice, and the modes of cultivating them.

For forage,—potatoes, beets, turnips, ruta-bagas, carrots, artichokes, parsnips, beans, cabbage.

Lucerne, lupins, sainfoin, common clover, trifolium incarnatum, vetches, peas, lentils, and plants for natural meadows and for pasturage.

To these are added, cobra, rape, poppy, mustard white and black, hemp, flax, cotton, madder, saffron, woad, hops, tobacco, chicory, teazles.

The weeds prejudicial to agriculture, and the insects which attack the plant while growing, or in the granary or barn.

The production of milk; and, as already said, the making of butter and cheese.

The production of wool; tests of its fineness; classing of wools; shearing of sheep; weight of the fleece; washing of wool before or after shearing; and every particular in reference to the subject.

The fatting of beef, mutton, and pork. Choice of animals for this purpose; nutritive properties of different kinds of food; in what form to be given; grains entire or ground; roots cooked or raw, green or dry; the value of the pulp of beet-root after the sugar is expressed; refuse of the starch factories; of the distillery; of the brewery; fatting by pasture or in stalls; comparison of the live weight with that of the animal when slaughtered.

Care and management of the various kinds of domestic poultry.

Care and management of bees, with the construction of hives.

Care of silk-worms, and their entire management.

All these studies are pursued in the first year of the course; and the time is so arranged as to afford the diligent pupil an opportunity of meeting his duties, though the period is obviously too limited for the course prescribed.

The second year enjoins the continuance and enlargement of these important studies; the higher branches of mathematics and natural philosophy; an extended knowledge of chemistry; and a thorough acquaintance with mechanics, when the scholars with their professor visit some of the principal machine-shops and factories in Paris, or its environs, in order to become practically acquainted with them.

The students are further instructed in the construction of farm-buildings of every description; in irrigation, in all its forms; in the drainage of lands; in the construction of roads; in every thing relating to farm implements; and in the construction of mills and presses.

As I have said, organic chemistry is largely pursued with the various manufactures to which it is applicable; and animal physiology and comparative anatomy are very fully taught.

These studies are followed by a course of what is called agricultural technology. This embraces the manufacture, if so it may be called, of lime, of cement, of bricks; the preparations of plaster; the making of coal by various processes; the making of starch; the making and purification of vegetable oils; the making of wines, of vinegar, of beer, of alcohol, of sugar from the beet-root, including all the improvements which have been introduced into this branch of manufacture; and the pupils, under the direction of the professor, are taken to see the various manufactories of these articles, so far as they are accessible in the vicinity.

The whole subject of forests, of nurseries, of fruit-trees, ornamental trees, trees for fuel, trees for mechanical purposes, are brought under the student's notice. This is a great subject in France, where wood has an extraordinary value; where immense extents of ground are devoted solely to the cultivation of trees; and where consequently it is most desirable to understand the proper kinds of wood to be selected for the purpose in view; the proper mode of forwarding the growth of the trees; and of removing them without prejudice to their restoration. Under this head comes the culture of

Trees for fuel.

Trees for timber.

Trees for house and ship-building.

Trees for fruit, including all the varieties adapted to a particular climate.

Trees for their oily matter; such as olives.

Trees for their bark; to be used in tanning, and other purposes.

Trees for their resinous properties; such as pines.

Osiers and willows for making baskets.

Mulberry-trees for the support of silk-worms.

Next to this comes the culture of vines, and the establishment and care of a vineyard—a subject of great importance in France.

I have already spoken of the veterinary course of instruction. This embraces the whole subject of the breeding and rearing of animals; their training, shoeing, and harnessing, and entire management.

Under the head of farm-accounts, the establishment itself at Grignon is made an example; the accounts of which are kept most accurately by some of the students, and open to the inspection of all.

A journal of every thing which is done upon the farm is made up every night; and these accounts are fairly transferred into a large-book.

To this is added, a particular account of the labours performed, and the occupation of each workman on the farm.

Next, a cash-book, embracing payment and sales, which are adjusted every fortnight.

Next, an account with the house; charging every article supplied or consumed.

Next, a specific account of each principal department of the farm; such as the dairy, with all its expenses and returns; the pork-establishment; the granary, &c.; which are all balanced every month, so that the exact condition of the department may be known.

As the students are advanced, more general and enlarged views of the various subjects of inquiry are given; such as,

The taking of a farm, and the cultivation or management to be adopted.

The influence of climate and soil.

The crops to be grown; and the rotation of crops.

Agricultural improvements generally.

The devoting of land to pasturage; to dairy husbandry; to the raising of animals; to the fatting of cattle; to the growth of wool; to the production of grain; to the raising of plants for different manufacturing purposes; or to such a mixed husbandry as may be suggested by the particular locality.

The use of capital in agriculture; the mode of letting farms; cash rents; rents in kind; rents in service; laws regulating the rights and obligations of real estate; the conveyance of real estate; with the various forms of culture in large or in small possessions, or on farms of a medium size.

I have extended, perhaps beyond the patience of my reader, the account of the Agricultural School at Grignon, and yet have given an imperfect and abridged statement of the subject matters of instruction and study at this institution. The institution at Grignon may be considered as a model establishment; and a thorough education in the various branches referred to, must be, to any young man, an important and invaluable acquisition.

The question comes up, Will such an education make men better farmers? It must be their own fault if it does not. There may be some branches of the prescribed course, which may not appear to have a direct practical bearing; but there is not one without its use; if not directly, yet indirectly subservient to agricultural improvement; and if not immediately applicable to practice, yet intimately connected with the agricultural profession, adapted to increase its power, utility, and dignity, to elevate and adorn it.

2. VETERINARY SCHOOL AT ALFORT.—I must not, in this connexion, pass over the veterinary schools of France. There are three of these institutions in France, and they furnish all the advantages to be expected from such establishments. The three veterinary schools established by the government of France are at Alfort, Lyons, and Toulouse, and comprise 600 students. The average number of horses kept on them is 1332; viz. 838 stallions, 127 mares, 212 colts, 99 fillies, and 56 draft horses[1]. The one at Alfort is that which I have had the pleasure of inspecting.

This establishment is beautifully situated on the river Seine, near the village of Charenton, about six miles from Paris. The buildings for the different objects of the institution are spacious and well contrived, and the grounds sufficiently extensive and judiciously arranged. Like other governmental establishments in France which have come under my observation, the institution is upon a grand scale, and complete in all its parts. The government of France, in a liberal manner, avails itself of the talents of the most competent men in every department, and of all the advantages which science and art can afford; and it spares no expense in the perfect execution of whatever it undertakes. It adds to all this, as is every where to be seen, a refinement of taste in the arrangement of the most ordinary subjects, which increases the expense only in a small degree, which does not abstract at all from the solidity and substantial character of the work itself; but relieves that which would otherwise be monotonous, if not offensive, and renders often the plainest subjects attractive.

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[1] Statistical Report.

The school at Alfort is designed to furnish a complete course of instruction in veterinary medicine and surgery; embracing not horses only, but all the domestic animals. A student at his entrance must be well versed in the common branches of education; and a full course of instruction requires a residence of four years. The number of pupils is limited to three hundred. Of these, forty are entirely supported by the government. These are educated for the army; and are required not only to become versed in the science and practice of veterinary medicine and surgery, but likewise in the common business of a blacksmith's shop, as far as it is connected with farriery. Students can be admitted only by the nomination or with the consent of one of the great officers of government, the minister of commerce and agriculture. The expense of board and lodging is about fifteen pounds, or eighty dollars a year; the instruction is wholly gratuitous, the professors being supported by the government.

The establishment presents several hospitals or apartments for sick horses, cows, and dogs. There are means for controlling and regulating, as far as possible, the temperature of the rooms, and for producing a complete and healthy ventilation. There are stables where the patients may be kept entirely alone, when the case requires it; and there are preparations for giving them, as high as their bodies, a warm bath, which, in cases of diseased limbs or joints, may be of great service. There is a large college with dormitories and dining rooms for the students; houses for the professors within the enclosure; rooms for operations upon animals, and for anatomical dissections; a room with a complete laboratory for a course of chemical lectures; a public lecture-room or theatre; and an extensive smithery, with several forges fitted up in the best possible manner. There are, likewise, several stands, contrived with some ingenuity, for confining the feet of horses, that students may make with security their first attempts at shoeing, or in which the limb, after it has been separated from its lawful owner, may be placed for the purpose of examination and experiment.

An extensive suite of apartments presents an admirable, and, indeed, an extraordinary museum both of natural and artificial anatomical preparations, exhibiting the natural and healthy state of the animal constitution; and, likewise, remarkable examples of diseased affections. The perfect examples of the anatomy of the horse, the cow, the sheep, the hog, and the dog; in which the muscular integuments, the nerves, the blood-vessels, and, indeed, all the parts, are separated and preserved, and exhibited, by the extraordinary skill of an eminent veterinary surgeon and artist now deceased, who occupied the anatomical chair of the institution, exhibit wonderful ingenuity in their dissection and preservation, and present an interesting and useful study, not to the medical students only, but to the most ordinary as well as the most profound philosophical observer. I have seen no exhibition of the kind of so remarkable a character.

The numerous examples of diseased affections, preserved, as far as possible, in their natural state, strongly attract observation, and make a powerful appeal to our humanity in showing how much these poor animals, who minister so essentially to our service and pleasures, must suffer without being able to acquaint us with their sufferings; and how often they are probably compelled to do duty, and driven to the hardest services by the whip or the spur, in circumstances in which a human being would not be able to stand up. A great number of calculi or stones, taken from the bladders of horses after death, are exhibited, of a large size, and, in some instances, of a very rough exterior, which must have excessively irritated and pained the sensitive parts with which they came in contact. One of these stones was larger than the head of an ordinary man, and weighed, as I was informed by the attendant, thirty-eight pounds. I am aware how severely this account may tax the belief of my readers, but I assure them there is no exaggeration, though I should have found great difficulty in believing the fact had I not seen the stone. It is scarcely possible to overrate the suffering which the poor animal must have endured under such an infliction[1].

The department for sick dogs, containing boxes for those which require confinement, and chains for such as require to be kept in the open air, and a cooking apparatus and kitchen for the preparation of their food, was spacious, well-arranged, and contained a large number of patients. Any sick animals may be sent to the establishment, and their board is to be paid at a fixed rate of charges; twelve sous or cents, or sixpence per day for a dog; and fifty sous or cents, or twenty-five pence, for a horse, including medicine, advice, and attendance. In cases of epidemics or murrain prevailing in any of the districts of France, the best attendance and advice are sent from these schools to assist in the cure, and especially to watch the symptoms and progress of the malady. In countries where large standing armies are maintained, and where of course there are large bodies of cavalry and artillery to be attended upon, as well as waggon-horses for carrying the supplies, the importance of veterinary surgery is vastly increased; but in countries where no standing armies exist, the number of horses kept for use or pleasure, and of other domestic animals, bears a much larger proportion to the number of human beings than we should be likely to infer without inquiry; and renders the profession highly important.

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[1] Facts of this nature strongly demonstrate the importance of pure water for our brute animals as well as for ourselves. Such diseases are most likely to occur in a country where the waters are strongly impregnated with lime. In Paris, where of all places which I have seen they appear least demanded by any excess of modesty, or even sense of common decency, it is said, that since the erection of public urinals along some of the principal streets, the diseases of gravel or stone in the human subject have greatly diminished.

A large and select library belongs to the establishment, and a garden for the cultivation of medicinal plants, and likewise of the grasses employed in agriculture. A farm is likewise attached to the place, on which instruction is given in practical agriculture, and numbers of various kinds of animals are kept for the purpose of breeding the best, and illustrating the effects of crossing. Some selected animals of domestic and of the best foreign breeds, horses, bulls, cows, and sheep, are kept for this special object. On one occasion, when I visited the institution, there was a public sale of bulls of the improved short-horns, which had been raised upon the place; and of some bucks of the best breeds of England, the Leicester, the South-down, and others from a cross of the Leicester with a large-sized Merino. I saw at Grignon the cross also of the South-down with the Merino. These crosses presented examples of improved form, of large size, and of a great quantity of wool of a good, but not of a very fine, quality. These were the result of a first cross; how far it may be successfully continued is not determined. Attempts of this kind, to intermix breeds of a decidedly different constitutional character, as far as my inquiries have been extended, have not been satisfactory after a first cross. These animals belonged to the Government, and were sold, not with a view to profit, but to the general improvement of the breeds of France. In this excellent mode, the Government provides, in respect to horses, cattle, and sheep, for the propagation through the kingdom of the most valuable races. The minimum price was fixed upon the animals as they were brought forward, and they went into the hands of those who made the highest advance, and who were required, under certain conditions, to keep them for the purposes of breeding[1]. Besides these sales, the best description of horses and neat cattle, studs, and bulls, owned by the Government, are at the service of the farmers upon the most liberal terms, for the improvement of their stock.

In England, the veterinary establishments are maintained by private subscription. Perhaps, in general, that which is left to private management under the stimulus of personal interest is better cared for than that which is wholly public property; but as in this establishment there is no want of liberality on the part of the Government, so there seems to be no want of fidelity and diligence in accomplishing its objects. The students are numerous, and the professors eminent for their scientific and practical acquirements.

3. Agricultural Colony at Mettray.—There are other institutions for agricultural education in France, which I visited with great interest, a notice of one of which will not, I hope, be unacceptable; the one at Mettray, near Tours, about 150 miles from Paris.

The colony at Mettray was founded in the spirit of the good Samaritan, which succours the wounded and forsaken

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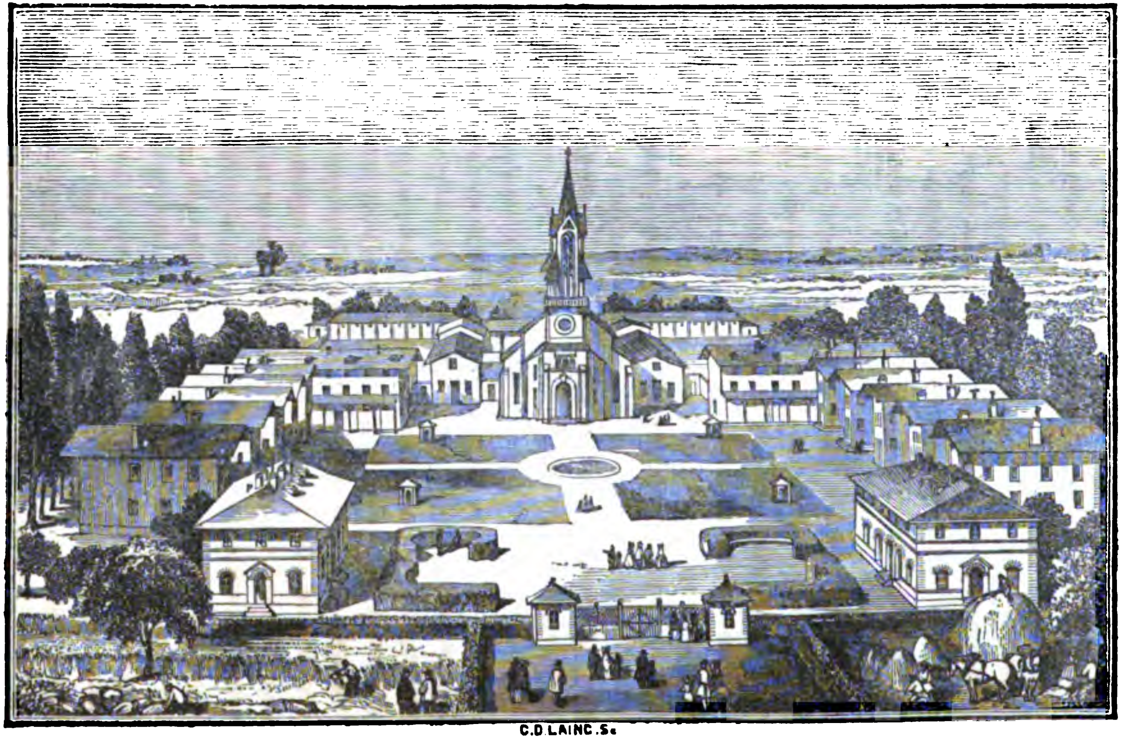
[1] The expense to the Government of supporting the three veterinary schools is said to be about 492,000 francs, or 100,000 dollars per annum.



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traveller by the way-side, takes him home, and there nourishes and cherishes him. This establishment grew out of the compassion of two gentlemen of high rank and fortune, who were moved to essay what could be done for the rescue of unfortunate, condemned, and vagabond boys, to save them if possible from destruction, and give them the power of obtaining an honest living. It is not consistent with my plan, in this place, to go further into the account of the institution, than as a school of agriculture, though the directors propose three objects of instruction: to qualify their pupils for farmers, sailors, or soldiers. The discipline of the institution is military. They have a full-rigged ship of ample size in the yard, that boys designed for naval life may here take their first practical lessons; and they have a well-stocked farm of five hundred acres, which is under direction to be cultivated by the pupils. The institution is situated in a healthy part of the country, and near a large market-town. They employ an educated and experienced agriculturist as director of the farm. The first object is to render it productive, that it may go as far as it can be made to go towards defraying the expenses of the institution; the second, to instruct the boys in the best and most improved methods of husbandry. The institution had its foundation in private subscription, and though in its commencement it had many difficulties to struggle with, it has now a firm establishment[1]. Besides a farm, there are connected with the institution a large garden, an extensive nursery, and a manufactory for the fabrication of all the implements, carriages, &c., which are used on the farm. The boys are likewise employed in the making of the shoes, caps, clothes, and bedding, which are required, and many fancy articles which serve for sale, and give them occupation, when by any circumstances they are prevented from out-door labour. The number of pupils is at present 450. It is not intended to keep them after sixteen, but they are willing to receive them at the earliest convenient age. I saw several not more than six or seven years old. They live in families of forty or fifty, in separate houses, under the care of a respectable man and his wife, who give them their whole time. This seemed to me a most judicious provision. They have a guardian with them in the fields, who always works with them. Many of them have been condemned at courts of justice for some petty offence, and many of them, orphans and friendless, have been taken up in the streets in a condition of miserable vagabondage. The discipline of the institution is altogether moral and paternal. Confinement, abstinence, solitude, and disgrace, constitute the chief punishments; but there are no whips, nor blows, nor chains. It has been so far eminently successful. A boy, who had been early familiar with punishments and prisons, and now for some time a resident at Mettray, was asked, Why he did not run away from Mettray? His memorable answer was, "Because there are no bolts nor bars to prevent me."

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[1] The Vicomte de Courteilles gave a large estate, and M. De Metz, a distinguished philanthropist and a royal counsellor, besides sacrificing his high situation at court, lives among the children, and gives, the greatest of all charities, his whole time, his hand, his head, and heart, entirely to this object.

When one looks at the innumerable herds of children, turned, as it were, adrift in a great city, not merely tempted, but actually instructed, stimulated, and encouraged, in crime, and observes them gradually gathering in and borne onwards on the swift current with increasing rapidity to the precipice of destruction, until escape becomes almost impossible, how can we enough admire the combined courage, generosity, and disinterestedness, which plunges in that it may rescue some of these wretched victims from that frightful fate which seems all but inevitable? I do not know a more beautiful, and scarcely a more touching, passage in the Holy Scriptures than that which represents the angels in Heaven as rejoicing over a repenting and rescued sinner. It is, indeed, a ministry worthy of the highest and holiest spirits, to which the Supreme Source of all goodness and benevolence has imparted any portion of his Divine nature.

If we look at this institution even in a more humble and practical view, as affording a good education in the mechanical and agricultural arts, its great utility cannot be doubted; and much good seed will be sown here, which, under the blessing of God, is sure to return excellent and enduring fruits.

I should have said before, that there is connected with the institution a hospital which was a model of cleanliness, good ventilation, and careful attendance; all the services of which were rendered by those indefatigable doers of good, the Sisters of Charity.

CXXIV. CROPS.

The crops cultivated in France are the usual cereal grains, wheat, rye, barley, and oats; but what may be called the peculiar crops, yielding an immense pecuniary value, are wine, silk, and sugar.

1. Wheat.—In gross amount, the wheat grown in France constitutes an immense crop. With the exception of Russia, from which no accurate statistical returns have been obtained, and in European Russia comparatively little wheat is grown, the bread used being chiefly of rye, it is stated, that more than half of the wheat grown in Europe is produced in France. From the best statistical accounts that can be obtained, the wheat annually produced in the United Kingdom,

England, Scotland, Ireland, is	111,081,320 bushels.
In France it is	198,660,000 ,,

The amount of seed ordinarily sown to the acre is from two to three bushels. The return of crop for the seed sown is represented as, in the best districts, averaging 6·25 for one; in the least productive 5·40 for one; but the mean average return for the seed in the principal wheat-growing departments is reckoned at 6·07 for one. These accounts must be considered as uncertain. Any person having experience in the case, knows how difficult is even an approach to accuracy. My readers may be curious to know the calculations which have been made in regard to some other countries in this matter.

NORTH EUROPE.

Countries.	Year.	Increase for seed sown.
Sweden and Norway	1838	4·50 for one.
Denmark	1827	6 „
Russia, a good harvest	1819	5 „
———, Province of Tambof	1821	4·50 „
———, Provinces north of 50° latitude	1821	3 „
Poland	1826	8 „
England	1830	9 „
Scotland	1830	8 „
Ireland	1825	10 „
Holland	1828	7·50 „
Belgium	1828	11 „
Bavaria	1827	7 to 8 „
Prussia	1817	6 „
Austria	1812	7·05 „
Hungary	1812	4 „

Switzerland, 1825, lands of an inferior quality, 3; of a good quality, 8; of the best quality, 12.

France, inferior lands, 3; best lands, 6.

CENTRAL EUROPE.

Countries.	Year.	Increase for seed sown.
Spain	1828	6 for one.
Portugal	1786	10 „

Countries.	Year.	Increase for seed sown.
Tuscany	—	. . 10 for one.
Plains of Lucca	—	. . 15 „
Piedmont. Plains of Marengo	—	. . 4 to 5 „
Bologna	—	. . 15 „

Roman States. Pontine Marshes, 20; ordinary lands, 8.
Kingdom of Naples—best districts, 20; ordinary lands, 8.
Malta—the best lands, 38 to 64; ordinary lands, 22, 25, 30[1].

It is obvious how difficult it must be to arrive in this case at any thing like exactness. The quantity of seed employed on the same extent of land is very different in different countries, but the product cannot always bear the above proportions to the amount sown. That I may be understood, let us look at Malta, where a return of 64 for one is given for the best lands. Are we to infer that in such case, if two bushels were sown to an acre, the ordinary proportion in France, the product would be 128 bushels per acre? or, if three bushels were sown, as in the best cultivation in England, the crop would be 192 bushels? In Ancient Egypt, the return is represented as 100 for one; in Byzantium, as 150 for one; in Ancient Libya, as 300 for one. No certain conclusions can be founded upon such statements. The distinguished traveller, M. Humboldt, states the average product of wheat in Mexico as 25 to 30 for one, and this on table-land elevated 8000 feet above the sea; and that, even on large farms, he found it 50 and 65 for one. In the Antilles he states the production of maize, or Indian corn, as 300 for one. But I have seen in several cases in New England, in the culture of Indian corn, a return of 400 for one; that is to say, the hills being three feet apart each way, a peck of Indian corn would be sufficient seed for an acre. If 100 bushels of grain is in such case produced on an acre—

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[1] Statistique des Cereales de la France, par M. A. Moreau de Jonnès. Paris, 1843.

and this sometimes happens—this is clearly a return of 400 for one.

Of the average yield of wheat in France it is not possible to form a conclusion on which entire reliance may be placed. Until a very large district can be taken, and the crops and land actually measured, no certainty can be attained; and then of course it must vary much in different climates, or expositions in different seasons, and under different modes of culture. At present it is altogether matter of conjecture, and it would be difficult to find two men of independent judgment who would agree in the case. The average yield in England I have heard stated by men of political standing, claiming to be well informed on the subject, at not more than fifteen bushels per acre. An eminent agricultural writer placed it at eighteen bushels some years since; men of sanguine temperament rate it at over thirty bushels. These evidently are wholly conjectural estimates. In France it is stated in the best districts to average twenty-two bushels. This rests upon similar authority. It would be of immense importance to any government to know the exact product grown in any county or district, or in the whole country; and this might be obtained by compelling, on the part of the owner or cultivator, an actual return of his crop; but it is of little use to found such returns on estimates purely conjectural. There is another point in respect to this cultivation which the agricultural societies might obtain, and which would be of great importance; that is, first, the smallest yield ordinarily obtained, and, next, the largest yield actually obtained, with a detailed history of the culture in each case; the causes of the inferiority in the former, and of the superiority in the latter, as far as they can be ascertained. Reluctant as most men are to state them, yet, as much benefit may be derived from a knowledge of the causes of failure as of success; and in the latter case, every one must see the importance of knowing what can be done, that every stimulus may be given to an emulation which in agriculture is always wholesome, and a great instrument of success. In England, fifty bushels per acre were reported to me, on the best authority, as the yield upon a large farm in a very favourable season. More than eighty bushels have been reported, upon what is deemed ample testimony, to the Royal Society of England, as the product of a single acre[1]. In France I have had, upon the best authority, reports of forty bushels, forty-four bushels, and seventy-two bushels. It is beyond all doubt that the crops in England have, within a few years, considerably increased; and, by the official returns in France, where much pains have been taken to render them accurate, it appears that within eighty years, while the population has increased in the proportion of twenty-one to thirty-three millions, the production of wheat has more than doubled; which shows an improvement in the comforts of the people. It is further stated, upon good authority, that the product of an acre of land is ordinarily double what it was three-fourths of a century ago; which shows a most gratifying improvement in the agriculture of the kingdom. It is an instructive fact, that the product of wheat in France has increased sixty-three per cent. since the close of Napoleon's wars—a fact which shows, in a most striking manner, the interruption which war brings into the useful arts of life, and the privations and wretchedness which are sure to follow in its train.

There have been in France, as every where else, discussions as to the origin of wheat, many persons maintaining that it is an inferior plant in its natural state, and that its present condition is the result of artificial cultivation. The speculation will do neither harm nor good. There is little reason for the supposition; and it seems extraordinary that similar changes are never witnessed at the present day. It is certain that the wheat cultivated at the present time does not differ from that found in the pyramids of Egypt.

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[1] It is almost impossible to get any exact return from an English tenant-farmer of his products, for the reason that he will give no occasion to his landlord to raise his rent. In countries where the amount produced is a subject of such great importance, and where the population is pressing so hard upon the supply, an accurate return of the yearly product should be induced by some pecuniary encouragement, or otherwise made compulsory.

There are nearly thirty different kinds of wheat cultivated in France, including both autumn and spring varieties. In respect to this distinction, there is little doubt that, by a careful selection of the earliest ripe, after a time, the autumn may be converted into a spring wheat; and the spring wheat being repeatedly sown in the autumn, would presently lose its properties of early ripening. It would be imprudent to prescribe any particular species for universal or for general use, as the different kinds are adapted to different localities, some being much earlier than others, and therefore, though yielding a less product, ripening before the droughts of summer, and escaping, in some degree, the dangers of blight; and others being more susceptible to injury from frost. The white wheat of Flanders is a highly esteemed variety; and is said to be the same as a wheat known in England by the names of the Eclipse wheat, the Wellington, and the Talavera. It is highly productive and beautiful, and is particularly suited to lands of the richest quality. The white wheat of Provence is pronounced the most excellent variety for the quality of its grain; its straw is very tender, and therefore liable to be lodged; and it is too delicate for a cold climate. The Lammas wheat is of an excellent quality; early in its ripening; it sheds its grain easily in the field; it therefore requires to be cut early. It is very susceptible to injury from cold. These are all winter wheats; but what is called a spring wheat in Europe is a wheat which should be sown in February; whereas, in the United States, that only is called a spring wheat which may be sown, with a surety of its ripening, in any part of March or April.

The Tuscan wheat, used in the manufacture of the celebrated and beautiful Leghorn bonnets, is a spring wheat, with very short heads, and produces little grain. The Victoria wheat, of a good quality, and brought to France from Columbia in South America, and represented as ripening in sixty days, was not found, in France, in advance of the common wheats of the country. I imported, some years since, a wheat from Spain, highly commended for its rapid growth and early maturity, but in these respects it showed no superiority over the kinds ordinarily cultivated in the country.

We are already, in the United States, in possession of many beautiful kinds of wheat. I can only add, if we could import a few of the French bakers to instruct us in the useful and important art of making bread, it might prove a signal advantage. I believe no where is so good bread to be found as in France; and this, not in the cities only, but throughout the country; even at the meanest village tavern you will ordinarily find bread of the best quality.

The Egyptian wheat, which I have seen growing several times in the United States, and which is known by its producing several heads upon the same stalk, is highly productive on rich land. Its flour, however, is not highly esteemed. It does not well bear the cold. It is liable to degenerate, and to produce, at last, only one head.

A large portion of the soil of France is unfavourable to wheat, from its excessive dryness. Though, beyond doubt, a soil partially calcareous is favourable to wheat, yet this quality in excess is unfavourable. The soil for wheat cannot be too good, though it would seem as though there were exceptions to this remark in some of the rich alluvions of the West; but it may be made too rich by manure, and especially by manure applied in too green a state. It is in general the custom to apply the manure to the previous crop, though in many cases, and especially where liquid manure is attainable, it is applied immediately before the sowing of the crop. This was particularly the case in the instance which I have given, of seventy-two bushels being produced to an acre.

A naked fallow is sometimes resorted to in France, especially where the land abounds in weeds, and more particularly the squitch-grass[1], which peculiarly infests the old lands in Europe. The quantity sometimes collected from land, in what are called even good farming districts, is surprisingly great, and would lead one to infer, in some cases, that it was the principal crop grown.

As to the crop which is deemed best to precede wheat, I shall give the opinions of the best farmers in one of the best cultivated districts in France. Where tobacco has grown, wheat succeeds to great advantage. The cultivation for tobacco is clean and careful, and the manuring abundant. Wheat follows hemp with equal success, because the cultivation of hemp is equally clean with that of tobacco, and it is even more strongly manured; but the straw of wheat which follows hemp is not so abundant as after tobacco. Wheat after cabbage yields less straw than after some other crops, but more grain[2]. Beans are by some farmers regarded as a crop propitious to wheat, but not so favourable as those crops to which I have referred; and by others it is believed to produce less grain, and that of an inferior quality. After Indian corn the wheat gives a good grain, but an inferior amount of straw; but in some localities it is represented as giving an equally good product in grain and straw. After lucerne, wheat is cultivated to great advantage; the lucerne strikes a deep tap-root, which greatly enriches the ground when it is turned in. Wheat succeeds well after clover, if the clover is good; if the clover is poor, the crop of wheat is likely to be inferior, which is in other words only saying, if the land is rich, the crop will be good; if in poor condition, the result will correspond. Potatoes are generally condemned as a crop to precede wheat. In parts of France where wheat is grown every second year, potatoes are frequently the intermediate crop; and then the wheat, as well as the potatoes, are manured. After turnips, wheat is stated to be richer in straw than in grain. The rotation differs in many places, sometimes wheat occurring every other year, and sometimes only twice in six years.

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[1] *Triticum repens.*

[2] "It is calculated that 120 sheaves of wheat grown after cabbages, will give more grain than 150 sheaves grown after tobacco."—Scherwz, "Culture D'Alsace."

I cannot look upon these various statements with all the confidence which some persons place in them. A presumption is always in favour of the general and long continued practice of any country; yet it is far from being an infallible test of what is good or best, because it is by no means certain to be the result of experiments carefully made, and as carefully noted. Two or three great points, however, seem to be fully settled; that the land for wheat cannot be too deeply cultivated, nor too thoroughly manured, in the crop of the preceding year; and that it cannot be too thoroughly cleaned. Mr. Coke of England, afterwards Lord Leicester, offered a large reward to any person who would discover a single weed among his crops, after their usual cleaning. The wheat plant sends out descending, as well as lateral roots. After land has been thus well prepared, it is not deemed best to plough more than two or three inches for the sowing of wheat. By many persons, in climates where the frost heaves the land deeply, it is deemed best to cover the seed of autumn-sown wheat by the plough. Where the land has been ploughed in the autumn, it is advised only to harrow the land in the spring, and harrow in the seed upon land thus prepared, and press it closely with a roller. Land is frequently after being sown trodden by men, but better by sheep: a practice to which I have referred in my remarks upon English husbandry.

In England, certainly by all the best farmers, wheat is sown in drills with a machine. These machines are in general, like many of the agricultural implements of England, where they admit of being so, heavy, complicated, and expensive; but they do their work in an admirable manner; and many of them are contrived so as to sow the manure, when in a state of powder, at the same time as the seed. Many of the French farmers sow their wheat in drills, and by a machine, but not of a very improved character. In Switzerland I found drill machines, invented and made in the country, not expensive, which certainly performed their work well. Experiments have been made in France of planting wheat in hills, six inches or more apart, by a hoe; making the hole, and dropping several seeds in the hill, as Indian corn is often planted in the United States. There must be obviously a great saving of seed by this mode; and the result has been pronounced successful; but I have not been able to get full information. It was said to be by this mode that a crop of seventy-two bushels to the acre was produced. The crop, while growing, was manured with liquid manure, and was kept thoroughly clean. This resembles somewhat the mode of planting by a dibble in England. Such a mode would, at first sight, be strongly objected to in the United States, because of the labour which it would require. There is often a difficulty in the United States of procuring labour for any consideration; but other things being equal, a wise farmer would not ask simply, what the labour would cost, but whether the result would compensate the labour.

The quantity of seed sown to an acre is ordinarily two bushels, more frequently less than more. The quantity depends somewhat upon the nature of the soil, a larger quantity being sown upon inferior than upon good soils. Somewhat depends likewise upon the time of sowing. If sown early in September, the plants have a longer time to grow, and tiller more abundantly than if sowed later. Early in September is the time ordinarily recommended for sowing wheat, where the previous crop can be got off and the ground be made ready. In situations where the winter is severe, late sowing is strongly recommended, so that the wheat may make little or no progress before the early spring. In this way the crop is secured from the injury of the frost, which, when it destroys the young lateral roots, is extremely unfavourable if not destructive to the crop. The wheat crop does not suffer from the severity of the cold where it is uninterrupted, but from alternate freezings and thawings. When the ground is expanded by the frost, the small roots of the young plants are broken and mutilated, and the plants being often thrown out of the ground perish.

The diseases common to wheat in the United States are equally common in Europe, the smut, the rust, and the mildew. A remedy or rather preventive of the first, in almost all cases successful, is well known in the United States,—the washing wheat in brine, and sprinkling it with lime. Probably, the only advantage of the brine over simple water is, that its adhesive nature makes the lime stick to the seed. A solution of green copperas is equally effectual; and sometimes arsenic is used. The last is objectionable, from the danger of having the substance about the premises. The wheat may be prepared two or three days before sowing, but it must not be allowed to become heated. If laid in a heap upon the floor, it should be occasionally stirred.

The rust and the mildew seem mainly due to atmospheric causes. When the wheat is particularly forced by alternate sunshine and rain, attended with extreme heat, when every species of vegetation is urged to the top of its speed, and especially where the land itself is very rich and the air stagnant or confined, it seems as if more sap were forced into the plant than it could dispose of, the vessels burst, and the plant in truth dies of repletion. My own experience and observation seem fully to confirm this theory. The blight of mildew is a different affection. The causes are not well ascertained, and the preventives equally undetermined. A distinguished German clergyman or pastor, and I may be allowed to add in passing, that to no profession has agriculture been more indebted for its improvements, after long and careful observation is of opinion, that three causes may produce it; the state of the atmosphere, when the plant is in a particular stage of its growth; an unfortunate choice of the time of sowing; or the particular condition of the soil. He has found that, in the same neighbourhood, the wheat in some fields has been badly affected, while in others it has escaped the mildew. This circumstance seems opposed to the atmospheric theory; yet in the same country, the state of the atmosphere may be different in different positions and aspects of the field. Every one must have experienced this in passing along a public road in an evening; without a thermometer we become sensible in different places to great variations of temperature. With us in New England late-sown peas seldom escape the mildew, or what is called the blue mould, which has seemed to me attributable to the heat of our autumnal mid-day sun, followed by the chilliness of our autumnal evenings and their abundant dews. The same theory may account for the facts which he mentions in regard to sowing. He has sown wheat in September, which has suffered slightly from mildew; in October, in the same year, which has suffered severely; in November, which has entirely escaped. The circumstances in these cases are not all given. It is, therefore, difficult to make up a judgment; but one would infer that the late-sown wheat was carried beyond the susceptible season. The influence which the condition of the soil may have upon the health of the plant in this matter, or how far it may be affected by the manure employed, are points not determined. In one district in Alsace it is said the farmers find their wheat liable to suffer from mildew, when it follows clover which has been highly manured; but the manure customarily used in this case is the manure of hogs, to which some are disposed to attribute this result. Nothing seems more uncertain, or rather more imperfectly defined than agricultural facts, excepting it be agricultural theories. In order safely to deduce a valuable or practical truth from facts, the facts must be accurately and exactly determined and observed; but few men have this patience of observation. All the circumstances under which they occur, likewise, should be known and considered. Few men have the capacity to discover and comprehend them; and, in many cases, it must be confessed that, in our present state of knowledge, they are with difficulty ascertained. This disorder is clearly not propagated as smut is; and liming the seed has no effect in preventing it. This farmer is of the opinion that it does not depend upon the manure employed; at the same time he is in favour of turning in a crop of clover as manure for wheat, rather than to apply animal manure. Some persons confound the diseases of rust and mildew. The result is much the same, but the appearances are different; the crop being in both cases nearly ruined. In the case of rust, the wheat becomes suddenly attacked and the stalks covered with literally a red rust, the grain ceases to fill, and becomes shrivelled. In the case of mildew, the plants become covered with a whitish mould, and the stalks themselves become discoloured in various places, and turn black, as in a limb where mortification has taken place.

I have obtained no information as to what is called in the United States the Hessian fly, from the eggs having been supposed to have been brought to the United States by the Hessian soldiers, who were the mercenaries of the British government in the American revolution. I cannot learn that it is known here. The grasshoppers, or, as they are here called, the locusts, become destructive to a wheat crop, when the grass fails in the fields. The grain-worm, of which I have given an account in my State Reports, and in other publications, does not appear to be known on the Continent, though they have heretofore suffered from it in England[1]. Such scourges seem often temporary or periodical.

I have spoken of the quantity and the preparation of the seed. It is said by some that shrunken seed, or seed imperfectly ripened, will germinate and serve for another crop as well as that which is perfectly sound. I believe it may be considered as an established axiom, that perfect seed is always to be preferred to that which has any defect. In many provinces new wheat is always preferred for sowing; but many experienced farmers advise to sow wheat which is a year old, as a security against smut; for though the crop may have been smutty, from which the seed in such case is taken, the smutted ears are said, in the course of the year, to lose their germinating power, and do not communicate the disease to those grains with which they come in contact. A farmer, however, can hardly excuse himself for neglecting to take the prescribed precautions against smut in the preparation of the seed, which have been usually found effectual; and it is obvious that if old seed is used in preference to new, a larger quantity is required to guard against the failure of such as have become effete. In some provinces, they deem it necessary to change their seed once in two or three years. But the reason given by some persons for this practice is, that the cultivation in these departments is slovenly and negligent, and so the wheat degenerates. I think experiments have fully demonstrated as applicable to all plants, that where the cultivation is good, and the kind itself good, we have only carefully to select from year to year the very best for seed, and there will be found no necessity for changing the seed; and the crop itself will be likely continually to improve. In some cases, and especially where the cold is severe, and the winds are strong, it is advised to plough in the seed-wheat to the depth of about three inches. The best cultivators advise this always, especially where the lands are light; but it is a slovenly mode, as practised by some, to sow it upon the stubble of a preceding crop, and merely harrow it in. If nothing else, the benefit arising from the decayed stubble or the clover, when turned under as manure, is thus almost wholly lost. Wheat which is to be sown on a clover stubble[1] is advised to be sown two or three weeks earlier than that which is sown after tobacco or hemp, that it may gain strength; and it is the custom where wheat is sown after tobacco, to spread the stalks of the tobacco crop upon the field, where they remain until the spring, when they are removed. I do not know the advantage of this, unless as a protection against the cold.

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[1] I believe there is an effectual remedy against this destructive insect, under whose ravages I have known the most promising crops completely ruined. The fly, from whose egg this insect or worm is generated, appears first at the time when the wheat is in flower. If at that time the growing crop is slightly sprinkled with newly slaked lime sown broad-cast over it, it will commonly save the crop. It will either prevent the fly depositing his egg, or by its causticity it will destroy it. The mode is of no importance compared with the result. The destruction of the crop is not evident until the time for harvest; and then, though the external appearance may be perfect, there will be found in the grain or kernel a small yellow worm or maggot which has completely destroyed it.

Nothing is more prejudicial to the success of a wheat crop, than excess of wet; either stagnant on the surface, or in the soil. I have as yet met with no cases of underdraining or subsoiling in France, but the value of this immense improvement will presently be understood. Where the soil is clayey and wet, wheat is sowed in beds or stitches, and the drains between them kept clear. Experiments have been made in some parts of France for the irrigation of wheat, and with success, where a porous soil or a sufficient drainage immediately carried off the water; but of course it operated most injuriously where the soil or the surface retained too much wet.

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[1] Wheat manured by turning in a green vegetable crop, is supposed to have less strength, and is therefore more apt to become lodged, than that grown after a crop which has been manured with rich animal manure. The occasion of the stalk of wheat being tender, and the wheat therefore more liable to fall, is said to be owing to a deficiency of silex in the soil. But there are few soils where this deficiency exists. I give these opinions as opinions resting upon respectable authority, but without vouching for them.

The cultivation of spring wheat, unless the land is prepared in the autumn, is liable to many objections. The spring season is crowded with labours which must then be accomplished or not at all. Land ploughed in the autumn, which is, from its position or the nature of the soil, liable to retain the water of winter, is difficult to be worked even by the harrow in the spring, and in an unhealthy condition for being sowed. Spring wheat, though making an equally good flour, and for some purposes more esteemed than any other, seldom yields so abundant a crop as autumn-sown wheat.

In some instances, wheat is carefully weeded and cleaned in the spring; but this, in examples under my observation, has not been executed by a machine, nor very perfectly done. Nothing can be more beautiful than the cultivation, in some parts of England and Scotland, where wheat is sown in perfectly straight lines by a machine, and then carefully cleaned by a horse-hoe. Though I have seen good crops of wheat in France, the cultivation in numerous cases was far from being clean. When the early-sown wheat is far advanced in the spring, it is sometimes mowed; but this practice is not approved. It is sometimes fed down by sheep, and with great advantage; but it is advised not to put horned cattle upon it. This feeding of the wheat should be done, however, only when the crop is very luxuriant, and before May.

The wheat is sometimes manured in the spring on the surface, where liquid manure is easily obtained. Ashes, wood ashes, either crude or leeched ashes, are applied to wheat with the greatest benefit. This is done in the spring when the wheat is harrowed. The harrowing of wheat in the spring, when it is a few inches in height, is practised and strongly commended by the best farmers. I have full confidence from experience in its utility. In England, where the wheat is cleaned and cultivated by a horse-hoe or scarifier, this is an effectual substitute; but where wheat is not cleaned by a machine, or where it is sown broad-cast, the practice of harrowing it with an iron-tooth harrow of considerable weight, and that two or three times, is strongly commended. This practice is said to have been suggested by accident to a common farmer, who, having sown clover upon his wheat in the spring, was afraid that in some cases the seed would not take, and ventured to harrow it in. He found to his surprise that the wheat which he had harrowed was much superior in the end to that which the harrow had not passed over. It is a general practice in some of the districts of France, to sow clover in the spring upon the wheat. This is a well-known practice in parts of New England, where it is sown upon the snow; and, I am sorry to add, sown in many cases in the chaff from the barn-floor, when, of course, a variety of weeds and worthless plants are sown with it. The dung of domestic birds, pigeons, or barn-door fowls, where it can be obtained, is sown with much advantage upon the growing wheat in the spring.

Where spring wheat is sown upon land ploughed in the autumn, which has not suffered from wetness, it is not necessary to replough it, but to put the seed in simply with a harrow and a roller. It has seemed to me that the European farmers sometimes labour their lands too much, as in turning in a clover or stubble crop or a grass sward, they take pains to break the sward, and bring all the vegetable matter to the surface, to be burnt in some cases, or to be dried and exhaled in others, instead of leaving it to its natural decay under the soil, and its conversion into food for the growing crop. They are hardly aware of the amount of this vegetable matter, as demonstrated by an eminent farmer in New England, and a farmer who would be eminent any where, who found, by actual measurement and calculation, that the vegetable matter in a common closely-fed, field, or meadow, weighing the roots as well as the tops, amounted in an acre to full thirteen tons[1].

The manures applied to wheat are a matter of great importance. Different wheats, or wheats grown in different localities, differ very much in their nutritious properties, or in the quantity of good bread which can be obtained from them. The valuable and nutritious qualities of wheat are supposed to depend on the proportionate quantity of gluten and albumen which it contains. This is ascribed by many persons to the nature of the soil in which it has grown, and to the kind of manure which has been applied to it. This theory is altogether probable, and perhaps sufficiently established to induce us to act in reference to it; and, therefore, to apply manures which are likely to contribute to the growing plant the elements required. But many other things may come into operation, such especially as the climate and temperature, and other influences which are as yet imperfectly understood by us. The quantity of flour yielded by different wheats varies considerably, as the millers well understand. A distinguished French chemist, in examining 21 different kinds of wheat, found that the average yield in flour was as 79 of farinaceous matter to 100 pounds of crude grain. But this flour differed very much in its constituents in different kinds of grain. In actual nutritious matter, the difference in different wheats was found to be as fourteen to twenty-one. These were wheats grown in different countries, and different latitudes. If this difference depended wholly upon climate, it would of course be entirely beyond our control.

In wine countries, it is known that in different localities the same species of grape produces a wine of an altogether different quality and value from what it does in others. The kind of grape, the mode of culture, the degree of ripeness, the mode of making the wine, the age of the wine, and, doubtless in many cases, various artificial processes, affect to a degree the quality of the wine produced; but, beyond all this, there is something in the locality which is believed to determine its character. The celebrated wine, known as Constantia, is the product of a very limited territory at the Cape of Good Hope. In passing up the Rhine, there was pointed out to me the estate of Prince Metternich, where the celebrated Johannisberg wine is produced; and it is produced no where else; and from this circumstance its production is a source of immense profit. These facts seem to demonstrate the truth of the reply made always to my inquiries in relation to the subject, that there is something as yet unascertained, some peculiarity in the climate, aspect, or soil, from which the product derived its characteristic properties. The same or similar circumstances may operate upon the quality of wheat; and it is obvious, as far as they are strictly local, dependent upon the climate and aspect, or upon any peculiarities of the soil which do not exist any where else, or upon any causes as yet unascertained, they are beyond our reach.

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[1] **Mr. Phinney, of Lemington, Massachusetts.**

But that the qualities of the wheat grown depend to a considerable degree upon the kind of manure employed, there can be no doubt. Some experiments in reference to this matter, made by a German farmer, may be interesting to my readers.

Wheats manured as underneath produced as below:—

		Gluten.	Starch.
1.	With human urine	35·1 . .	39·3
2.	„ oxen's blood	34·2 . .	41·3
3.	„ human excrements . .	33·1 . .	41·1
4.	„ dung of sheep	22·9 . .	42·8

	Gluten.	Starch.
5. With dung of goats	32·9	42·4
6. „ „ horses	13·7	61·6
7. „ „ pigeons	12·2	63·2
8. „ „ cows	12·0	62·3
9. Soil not manured	9·2	66·7[1]

I am unable to say how far these experiments are to be depended on; and how far they have been confirmed by other experiments made with the same intention. Two things are quite remarkable in respect to them; the one is the different qualities of grain grown with manures of the greatest efficacy, and that grown without any manure, being a difference of nine and thirty-five; and the comparatively low result of pigeon's dung, which is generally rated very highly, and supposed to take its place with guano. The manner in which the animals whose manure was used for these experiments were fed, is a circumstance which may have materially affected the results: for the qualities of the manure of the same animals, under different courses of feeding, may be expected to be composed of different elements, and so to give different results; so complicated necessarily are all experiments of this kind.

The farmers in France are behind no others in what may be called, technically, agricultural science; and some of those eminent men, who are sometimes called farmers of the closet, have gone into the most exact and minute mathematical calculations as to the actual amount of certain mineral elements, which are supposed essential to the growth of the crop, or of any particular crop; and next, as to the amount of these mineral substances, which any particular crop carries off in the straw, and in the grain. They then proceed to determine the exact amount of these substances, which must be restored to the soil in order to keep up its fertility. The first point is determined by analysing with great chemical exactness a portion of the soil; the second, by analysing a portion of the crop, of the straw, and the grain; and these premises being obtained, the third is of course matter of plain inference. These calculations are curious and ingenious, and if vegetation or the growth of plants were as simple an affair, and as well and as easily understood as many pretend that it is, these facts would have a most direct and immediately practical bearing. One of the most eminent of these calculators, however, himself admits that the application of these facts, or rather the rules deduced from them, is an operation difficult, delicate, and which only the most skilful persons can undertake[1].

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[1] Cours D'Agriculture, par Gasparin.

In the present very imperfect state of our knowledge of vegetation, I am free to express my conviction, that they will answer no other purpose than that of mere curiosity and amusement. In the analysis of a soil, for example, if we suppose that a cubic foot is taken, this may be a very inadequate representative of other parts of the field. If the soil is taken from the surface, or that part of the soil which is cultivated, yet there is the soil under this, into which the roots of the plant may extend themselves, and which may contain elements of which we are not apprised. In the chemical analysis of a soil, it is known, likewise, that much of the active portion, all the vegetable portion, is dissipated by heat, and no account is obtained of it but by the loss in weight. The analysis of a soil, likewise, though it may give all its component parts, is sure to destroy their combination, and disturb the relations which they held to each other. There is another great omission in this case. Notwithstanding all the analyses which have been given of soils and products, where the amount of mineral elements removed have been most particularly determined, yet I have met with no instance of the analysis of a soil immediately after the removal of the crop; by which, on comparison with its condition at the time of sowing, the actual loss could be detected. This is a great desideratum, which we may hope will presently be supplied.

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[1] Gasparin's Course of Agriculture, vol. iii. p. 405.

A great many exact calculations have been made in reference to the weight of straw compared with the weight of grain, and the weight of stubble, when wheat is reaped with a sickle, compared with the whole weight of grain and straw. These results must, in different cases, be so affected by the seasons and soil, by the amount of crop, by the time which the plant has had to mature itself in, by the height at which the grain is cut, and by the condition of the straw when dry, that it would be difficult to draw any practical rule from them. In ten different experiments made in reference to this point, which have been shown me, no two agree.

In respect to the manures proper for wheat, I shall say something in another place. Every one seems to acknowledge the value of potassium, the principle which is found in common wood ashes. This accords with the result of my own experience and observation; for when called upon, in the way of my official duty, to examine the modes of cultivation and manuring, in no less than thirty-six hundred experiments in the culture of wheat, I found that wherever ashes were used upon the field, their efficacy was emphatically commended. The chemical analysis of wheat, taking straw and grain together, gives only a small proportion of this principle in the whole mass, such as 2 parts in 300; but this seems evidently indispensable. Whether it is absolutely necessary in a certain proportion, as food of the plant, or whether it operates in preparing other matters in the soil to become food for it, I shall not presume even to give an opinion. I must submit to minds qualified by the high attainments of science, to follow out inquiries so subtle, and at the same time so curious.

I have occupied the attention of my readers a long time on the subject of the culture of wheat, because of its immense importance. In the United States we cannot be said as yet to have known want; but in the years 1812 and 1816 there was, throughout the whole of New England, an almost entire failure of the crop of Indian corn; and it was not until such experience came upon us that many persons were fully sensible how much and how essentially this product entered into our daily wants. The wheat crop has become infinitely more important, for, with the exception of the slave states, I do not know a district of the country where it does not form by far the principal food of the population. But one has need to have lived in Europe through a famine to know the immense importance of any great and general article of subsistence; and the suffering among the mass of the community, which follows even its scarcity, still more the miseries and horrors which its total loss brings upon them. It is a fact which, as long as human memory endures, will stand out in bold relief on the darkest pages of history, that, in the years 1846 and 1847, in a country not so large as New England, by the blight of a single crop, not less than 116,000 of human beings actually perished by the awful death of starvation, not to add the thousands, I may add safely the hundreds of thousands, who were swept away by diseases engendered by unwholesome or insufficient food; and not to recur to the awful sufferings of the thousands and thousands who had strength enough to struggle through this trial, and in the midst of this dreadful shipwreck were just able to reach the shore.

With a rapidly increasing population in all parts of the civilized world, the production of bread is obviously the first object to be sought after, alike by the statesman and the peasant. I scarcely dare give the calculation of the immense amount which would be realized in any great country, by the single saving of a bushel to an acre, in the quantity of seed ordinarily sown[1]. The same result would follow if an additional bushel could be produced in the annual average yield of the wheat crop. Even this simple result would be an ample compensation for all the labours and expenses of all the agricultural societies now existing in the world, and the premiums by which, in any country, the Government have aimed to enlighten and stimulate production. I have not a doubt that, under an improved culture, not only may there be such an increase as to defray all additional expenses, but to add an average increase of five bushels to an acre. It is impossible to exaggerate the advantages which would result from such an improvement.

In looking back upon what I have written on the culture of wheat, it may not be without advantage to revert to some prominent points.

The soil in which wheat is grown to most advantage is a deep aluminous soil, but not so clayey as to prevent its being thoroughly cultivated. It requires, therefore, a good mixture of calcareous or siliceous matter. A soil of excessive lightness or looseness is not favourable to wheat, and a hard and impermeable soil equally uncongenial.

The soil cannot be too deeply cultivated for wheat. The roots of the wheat plant descend perpendicularly, and spread

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[1] The annual amount of seed for wheat sown in France is estimated at 32,491,978 bushels.

If we could suppose a third of this saved, the saving would amount to	10,863,959 bushels per year.
Suppose an annual increase of the crops of five bushels per acre, this would give an increase of production of	54,319,795 bushels.
Add this, under improved cultivation, to the amount of seed saved, and the result would be	65,183,754 bushels.

I believe, under an improved agriculture, this is quite practicable. What economical object could be more worthy of the Government of a country than, by every means within its reach, to encourage such production?

themselves laterally and broadly in search of food. It would be a mistake to plough too deeply for wheat at the time of its being sown; and it is always useful to roll or tread the soil after it is sown; but it is desirable that it should find a deep mellow bed below; and this is the case when it succeeds such plants as madder or tobacco, or especially where the soil has been deeply and thoroughly trenched.

Wetness is peculiarly unfriendly to wheat. Surface water, that remains long upon the land; or wetness, which stagnates and remains long in the soil, are highly prejudicial to wheat. This gives the great value to the Deansten system of draining and subsoil-ploughing. The water which falls in such case soaks immediately into the ground and is carried off. Where there is no subsoil-ploughing, and where the soil is of a retentive nature, the laying up the soil in narrow, slightly rounded beds or stitches, so that the water may pass off at once by the intervals, is highly important.

Wheat land cannot be too clean, or be kept too clean from weeds; and for this reason it should follow a crop which has been kept thoroughly weeded. The small kinds of clover may be advantageously sown with or upon wheat in the spring. This will not impede the growth of the wheat; it in some measure serves to keep down weeds; it protects the ground, in hot climates, from the great power of the sun, after the wheat has been cut; it furnishes some food for stock, after the wheat has been harvested; and it enriches the land greatly, when it comes to be ploughed in.

Wheat should be sown in drills four to six inches apart, or better dibbled, or sown in hills, which is not an excessive labour, where it is done by skilful and experienced hands. In any event, whether sown broad-cast or in drills, it should be cultivated, and the ground carefully stirred by the harrow or the scarifier.

Early sowing is strongly recommended in warm climates, so that the crop may come off before the extreme heats of summer; but it is advised, in cold climates, to sow wheat quite late, that it may not make any, or but slight progress, so as to be exposed to the severe frosts of winter, but be ready to show itself with the earliest spring. The climate of Great Britain is deemed peculiarly favourable to wheat, because of its equable temperature, and its humidity. The plant grows a longer time, and is longer in maturing itself. The harvest in England and Scotland comes off ordinarily a month later than in the United States, where the extreme heat of summer often renders the plant prematurely ripe. The wetness of the climate in the former, however, makes the harvest more precarious.

Of manures for wheat, it is ordinarily best that they should be given with the preceding crop. Green, or coarse manures from the stables, applied directly to wheat, are universally deemed objectionable. The effects of lime on the soil may be considered as threefold; first, in dividing a tenacious soil, and rendering it friable; second, in preparing the vegetable matter in the soil for the nutrition of the plant; and, in the third place, some portion of it may be taken up with advantage by the plant itself. The principle of potassium in the soil, in the form of common wood-ashes or otherwise, seems always highly beneficial, and almost indispensable. Liquid manure, urine diluted with water, is sometimes applied to the growing crop with great advantage. I have known also the water in which flax has been rotted applied with remarkable success.

The harvesting of wheat should take place rather early than late; that is, while there is a degree of greenness about it, rather than to wait until it becomes perfectly dry, as in such case much will be lost in shelling out. In the former case, it becomes ripe in the shock; and it seems well established that, when cut early, it makes better bread, and more is obtained from the same quantity of flour.

These are the great axioms which I have gathered in respect to the cultivation of wheat on the European continent. The importance of the subject will be a sufficient apology for my pursuing it at this length, though I may have added little to the knowledge which exists in my own country; and though, in many parts of the United States, as I well know, the practice may be already highly improved. When all its various uses are considered, the ease of its cultivation, the great amount, under good and liberal culture, of its production, and the few accidents or maladies to which the crop is liable, and more than this, the amount which it returns in manure to the land, I know no plant or crop so valuable as that of Indian corn (maize), in countries where the climate admits of its ripening; but wheat has the universal pre-eminence in public estimation; its use in civilized countries is daily becoming more general, and is taking the place of all coarser grains; and, in a commercial view, as well as an article of subsistence and luxury, it will continue to occupy the highest place among the cereal grains.

2. SPELT.—There is cultivated in parts of France and in Flanders, an inferior kind of wheat, called spelt (in French *épeautre*[1]), which mainly differs from other wheat in that it retains the husk on the grain, until separated by a machine. It is in many places used for bread; and in nutritive matter, as far as chemical examination goes, it bears a proportion to wheat of thirty-nine to fifty. It is said to exhaust the soil much less than wheat, but this point is controverted by high authority. It will yield well on a poor soil, and for this it is often chosen; but it will afford, also, an ample compensation for good treatment. The straw is stiffer than that of wheat, and though harder, is preferred by cattle. It will bear to be cropped once or twice in its early growth for green forage, and is deemed excellent for this purpose. It endures the

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[1] *Triticum spelta.*

drought like rye, and will grow well upon lands which are too light and dry for wheat. The difference between the weight of the grain of spelt with its husk on, compared with wheat, is as forty-two to seventy-six; and the ordinary difference in price is as seventy-two to one hundred, allowing for the extra expense in hulling and grinding. Under very good cultivation it is stated to yield about thirty bushels to the acre, with the hull, or in the husk.

Of this grain there are two kinds ordinarily cultivated, the red and the white. Some of each kind are bearded, and some without beard; and there is a spring and an autumn variety, although, by careful selection of the earliest ripe, the autumnal is without difficulty converted into the spring variety. It is said, likewise, that under a negligent culture, the beardless will become bearded, and that under a good culture and a rich soil, the bearded will lose its awns. The red variety is preferred, as more hardy, and suffering less from wet or cold, as giving a stronger and more abundant straw, being less subject to disease, and producing a better flour.

The quantity of seed required to an acre is double of that for wheat, because it is sown in the husk. A crop of hemp is sometimes taken from the land; if this is got off early, turnips are then sown, and after the turnips, spelt. If the crop of potatoes are kept clean, spelt is sometimes sown after them; in which case the land is not ploughed, but simply dragged or scarified, and the spelt merely harrowed in. If it is deemed necessary to manure the land in such case, the manure is spread on the potato ground, the seed then sown, and both thoroughly harrowed in.

With the husks adhering to the grain, spelt is said to furnish a substantial and excellent provender for horses. The straw being very strong, it is much sought after for the manufacture of hats. It is not a saleable grain in the markets, because wheat is generally preferred, and because the millers object to the grinding of it.

I have heard of a crop of ninety-four bushels to the acre, but I lack faith in results so extraordinary. In comparing this with wheat, it is to be remembered that this was measured in the husk.

The proportions of spelt in the straw, without taking any account of the stubble, are given as follows:—

Grain-clean	46·38
Husks	15·05
Straw	36·43
Loss	2·14
	100·00

And 100 parts of the grain in the husk give as follows:—

Grain-clean	72·96
Husks	23·67
Loss	3·37

These results can be considered only as approximations to exactness, as they must be affected by a variety of circumstances.

There is a smaller and inferior kind of spelt[1], which is only cultivated where it is thought too poor even for rye or oats, but which yields very little. The flour of this grain is excellent for some domestic purposes, and it is thought to pay the little care and labour which it receives.

3. RYE.—Rye is very extensively cultivated in Europe—in Great Britain to a small extent; on the Continent, and especially in the northern portions, it forms a principal part of the bread of the people. In Germany, in Belgium, in the cold and mountainous districts of France, and in Russia, it is their main dependence. To the Flemish it has been a great

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[1] *Triticum monococum.*

source of wealth through their distilleries, not only in the liquor extracted from it, but in the number of swine and cattle supported and fatted in these distilleries, and the abundance of manure in this way produced. There is a debtor side to this amount in the Pandora's box of evils, which such a product always opens upon the community, in the crimes, and misery, and degradation, of which it is the fruitful source; but I shall leave this, as somewhat foreign from my subject, to the sober calculation of my readers[1].

The bread from rye is not deemed so nutritious as that from wheat, but it is healthy and good; and a distinguished German maintains that it has a sovereign efficacy for persons whose nervous organization is exhausted or deranged by sedentary pursuits or intense application to study.

Rye succeeds even on a light and dry soil. A clayey, or wet, or calcareous soil is not congenial to it. It grows well even upon a sandy soil, where scarcely any other grain will succeed. There is no grain cultivated which yields so large an amount of straw; and this renders it valuable for litter and for the means of further enriching the soil. The straw is valuable for many other purposes; and particularly for thatching both houses and stacks of grain. In France, vast amounts are used in protecting their wine, when it is transported from one place to another, from the sun, and in covering other merchandise on its way to market. It is said that four crops of rye do not exhaust the soil so much as three of wheat; and, indeed, it has come within my own experience in the United States, that where rye has been cultivated for a considerable term of years successively on the same land, and early clover has been sown upon it in the spring, and ploughed in with the stubble in the autumn at the time of sowing for the next crop, the land, without any other application, has been in a course of gradual improvement, and the yield of rye continually increased. This is a common practice among the best Flemish farmers, and highly approved.

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[1] The distilleries in Holland, under the imposts of the Government, and the heavy duties upon the introduction of their produce into France, have been almost entirely destroyed.

Each of these distilleries in the course of a year fatted 180 head of cattle. The amount of grain consumed at each of them was estimated at 276,765 bushels. These establishments, besides the powerful stimulus which they gave to cultivation, in the market which they afforded for the grain produced, furnished likewise the most abundant supplies of the richest manure.

There was this advantage also arising from them, that in case of scarcity or famine, the immense supplies of grain which they always had on hand, were diverted from the manufacture of gin to the supply of bread for the people. This was giving the loaf instead of the scorpion.

Of the rye cultivated, there is the winter and the spring rye, which differ from each other only in the time of sowing, excepting that the rye sowed in the autumn is more productive than that sowed in the spring, having a longer time to grow in. The rye, which I have described in another place as the St. John's-day rye, and which has been recently introduced into England, is known in France as the multicaulis or many-stalked rye. It is sown in June, and will bear cutting two or three times for green forage, and yet yield a good crop. It has the property of tillering or spreading from the root very abundantly, though it is maintained by some farmers that other kinds of rye, managed in the same way, would show the same properties; and the multicaulis rye sown late in the autumn loses this property. The grain of the multicaulis rye is not so saleable in the market as other rye, from its small size.

The general cultivation of rye is so well understood, that I need not enlarge upon it. The best farmers advise not to apply fresh barn-manure to the crop, but prefer that which is decomposed, or that it should follow a crop which has been well manured and cleaned. It does not succeed well on lands subject to fogs, and, therefore, they cultivate little of it directly in the neighbourhood of the Rhine. The straw is abundant, but the grain does not fill well.

The principal disease to which rye is subject is the ergot, in which the kernels of the grain become swollen, and form a black horny substance, well known among medical men as a powerful agent. This prevails much more in some years than in others; and when care is not taken to separate it from the grain before it is ground, which can be done by careful winnowing or sifting, it is productive of fatal disease, driving often to insanity, and producing mortification in the limbs. The spotted fever, a species of plague which prevailed in parts of New England with such a melancholy fatality in 1812, was attributed to the use of this diseased grain. In 1816 it was fatal in some parts of Germany; and it is said that in one case, where the soldiers in garrison were fed upon bread made from this diseased grain, a tenth part of them died.

The subject of harrowing rye in the spring, so urgently recommended in the cultivation of wheat, is a point contested by intelligent farmers, some strongly recommending, others as strongly opposing the practice. If the rye is far advanced, it certainly cannot be advisable; but the authority by which the practice is enforced is so high and practical, that I should be strongly disposed to try it, where the condition of the rye admitted of it. The spring-rye yields a crop inferior, both in quantity and quality, to that which is sown in the autumn. I have spoken of the multi-caulis rye as a valuable forage when sown in June, and cut green. Its earliness in the spring would give it a value in the United States, but later in the season we have a substitute in Indian corn, altogether superior.

The ordinary weight of a bushel of rye is from fifty-five to fifty-seven pounds, and the proportion of grain to the straw and chaff is as 100 to 292. These proportions, however, must be obviously affected by the size of the plant, and the height at which it is cut. The culture of rye has seldom had half justice done to it. The colour of the product is, I believe, mainly dependent upon the nature of the soil in which it is grown. There is a prejudice against the black bread made in many parts of the country; but the white rye produces a bread scarcely differing in appearance from wheat, and of great sweetness. For feeding animals it is of much value; when cooked, one pound of rye is rated as equal to three pounds of hay; and I have a friend in France, who would be esteemed as one of the best farmers in any country, who keeps a large number of horses, and feeds his horses upon rye-bread, whenever the relative prices of hay and rye render it eligible.

4. BARLEY.—Barley is not largely cultivated in France, as wine forms the principal drink of the country. The use of beer, however, is said to be extending, and consequently the cultivation of barley.

There are said to be three kinds of barley, in reference to the season of sowing; winter barley sown in autumn, spring barley, which is advised to be sown as early as possible on the opening of the spring, and a kind which is sown still later, under the name of summer barley. There is also another division into six-rowed barley and two-rowed barley, and these two kinds have their sub-varieties. There is a kind called the celestial barley, to which the husk is strongly attached; but which, when threshed, becomes what is called a naked barley, the husk falling off, and the grain itself being semi-transparent. It is a good bearer, but ripens late; and in general, the naked barleys, though cultivated for soups or for domestic uses, are not much sought after in the markets. There is another kind, called the coffee-barley, which is also a naked barley, the grain of which is stated to be as heavy as that of wheat, but the straw is not strong, and it is liable to be lodged. It is threshed with difficulty, and it is very subject to smut.

The kinds usually cultivated are the common six-rowed and the common-two rowed barley. This latter grain is extremely hardy, and was found cultivated in Lapland, as high as 67° 20′ north. The winter barley is said to produce a much heavier crop than the spring-sown; and where the spring barley is sown, it is advised to get it in as early in March as possible. The quantity of seed employed is one-third more than that of wheat. In many rotations it follows wheat; and in such case it is strongly urged to turn under the stubble as soon as the wheat crop is removed. The neglect to do this for any length of time will be greatly to the disadvantage of the succeeding barley crop.

The soil for barley cannot be too rich or too well cultivated; and it should be kept as clean from weeds as possible. No plant is more rapid in its vegetation; and, therefore, if manure is applied to it, it should be in that decomposed state that it may be immediately available for the uses of the plant. This, of course, applies more to spring than to winter sown barley, which has a longer time to grow in. The soil for barley should not be a hard soil, or one apt to be baked by the sun, as the roots of the plant have a tendency to spread themselves, and therefore demand a loose and friable soil. Barley is often taken after potatoes; and, in that case, as soon as the potatoes are removed, the land is turned over with the plough, and in the spring it is again lightly ploughed, the barley sown, and covered with a harrow. Clover is sometimes sowed at the same time, and a light roller passed over it. For barley sowed in the autumn, it is not objectionable that the land should be moist; but when sown in the spring, the land cannot be too warm and dry. If the land is clayey and cold, the barley is not sowed so early as in other cases.

The Flemish cultivation of this crop is extremely careful and liberal; and no where are better crops to be found. The *polders* in Flanders are those lands which, by embankments, have been redeemed from the sea, or from the floods of the rivers, and then drained by cross ditches. These lands, being the alluvial deposits of uncounted years or centuries, are extremely rich; and large crops of winter barley are grown upon them. Crops as good, however, according to the testimony of a distinguished farmer, are grown upon lighter lands, where they are carefully cultivated, and liberally manured. The brewers prefer the barley grown upon the light lands to that grown upon the heavier soils; they find the skin of the grain finer, and the grain itself better filled. They prefer, likewise, the winter to the spring barley, because it weighs heavier. It gives, likewise, a larger product.

In the neighbourhood of Ghent, where one witnesses the perfection of agriculture, the mode of cultivating this crop is thus in the main detailed by an experienced agriculturist, to whom I have already referred[1].

They plough the land twice; they then lay it in beds of about five feet in width; they then go upon the land with a cart of liquid manure, the horse walking in the furrows, and a good deal of the liquid of course falling in the furrows, between the beds; they then level the land with a harrow; they then spread upon the field ten or twelve two-horse loads of rotted manure to the acre, and sow the seed upon the manure; the next step is to clean out the furrows between the beds with a spade, spreading the soil taken out upon the seed, and at the same time covering the manure. The whole field is then trodden by foot, or by a roller drawn by men. The object of this is to retain the humidity in the soil, so that the seed may come up the better. When the seed is two or three inches high, it is then manured again, with a copious dressing of liquid manure, so that the field is in a condition to bear a crop of potatoes or of turnips the same year. Where the liquid manure is from the privies of the town, it is necessary to dilute it with water. The roots of barley, spreading upon the surface rather than descending deeply, it is not necessary to bury that or the manure deeply, although where barley is sown in the autumn, it is generally advised to plough it in with a light furrow. The crops in such cases are very large, averaging more than sixty bushels to the acre. The general cultivation in Flanders is most remarkable for its carefulness, its most abundant labour, and its liberal manuring. I do not know where I should go to find that which is superior to it; and, indeed, it would be difficult to produce its equal. The farmers of the United States would be startled at the amount of manual labour bestowed upon their lands by the Flemish. A redundant population gives them the means of doing this with great advantage.

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[1] Van Aelbroeck's Agriculture of Flanders.

It is well established that barley may succeed wheat, but wheat does not well follow barley. Turnips are often taken after barley, and a crop of rye after the turnips. Beans, likewise, follow with advantage a crop of barley.

5. Oats.—Oats can hardly be said to be largely cultivated in France. They are grown exclusively for the use of horses. This however is more in the north than in the south. The stimulating and exciting character of oats as feed for horses, renders them much more useful in a cold than in a warm climate. Oats are supposed generally to be adapted to almost all soils and climates; but, like other products, they repay a careful and liberal cultivation. It is pretended by some persons, that a crop of oats ameliorates rather than exhausts the soil. This may be the case where oats are grown upon a turfy soil newly turned up; that is to say, it may be the best crop by which to reduce such a soil into a condition for cultivation; but that it otherwise enriches a soil can hardly be believed. It is the opinion, however, of many farmers, that sooner than any other crop, it avails itself of the nutritive parts of the soil, and reduces and extracts manure from ligneous matter contained in the soil, and that it will, better

than any other crop, bear the application of coarse manure. I give these opinions, as I receive them, from good authority.

There are several varieties cultivated, divided by the French into white and black; by the Flemish, into white, yellow, and black. The white oat is most congenial to a soil which is humid, the black to a dry soil. The black oat in comparison with the white is represented as worth an eighth more for use; that is, it is more nutritive in the same weight, and its cultivation less exhausting to the soil.

The Hungarian oat, called sometimes the Tartarian oat, with all its panicles pendant on one side, is here found under two varieties, the white and the black. This species weighs heavier than the white, but not so heavy as the common black oat. It gives more grain and more straw than the common white oat, but it requires rich and strong land.

The potato oat is very little cultivated in France. Indeed, it can only succeed under a far better cultivation than is here bestowed upon the crop. The Siberian oat is of early maturity; the grains are yellow and very heavy, but the straw hard and coarse. The growth of this kind is so rapid, that it is said to have been cut when young for a green crop, and afterwards yielded a good grain crop.

There are two kinds of oats cultivated in France, known as winter and spring oats; the former kind being sown in the autumn; but this kind is only safe in parts of the country where the winters are mild, as oats are liable to be destroyed by severe frosts.

The best crops in France, rating thirty-three pounds to a bushel, give about forty-eight bushels to the acre, but a great portion of the crops give much less; and the average crop is rated at about sixteen bushels per acre, which indicates very negligent cultivation;—an eminent French cultivator calls it detestable, but it would not be civil in a stranger to use so harsh a term.

The value of oats, compared with hay, in nutritive matter, is rated at 100 to 175. It is strongly advised by the French farmers to use the oats without threshing, cutting up the grain and the straw together; and by all means, to harvest the oats at so early a season that they may not shell out upon the ground; as much is always lost in this way, when they are suffered to become perfectly ripe before cutting. The quantity sown to an acre is four bushels.

The Flemish farmers obtain very large crops of oats where their land is cultivated with a spade, or otherwise deeply cultivated. With them, the white oat weighs heavier by the bushel, but the yellow oat gives the largest crop, especially on their meadows. They cultivate their oats upon stitches, of a width greater or less according as the soil is wet or dry. They say that oats require not so much manure as barley by one-third; but they prefer manure that is well-rotted, that the plant may be forced as rapidly as possible. When the plant is a fortnight old, they apply a dressing of liquid manure. Such cultivation is evidently expensive and laborious; but, as in almost all other cases, extra carefulness is compensated by extra product. Sometimes the liquid manuring is repeated, and even more than once. In planting, they are careful not to bury their seed too deeply, two inches being deemed ample.

The great evil to which the crop of oats is subject, is the smut; but for this as yet no preventive has been discovered. The sowing of smutty seed is sure to produce it.

6. **MESLIN, or MÉTEIL.**—The French have a custom of cultivating what they call *méteil*, but what is called in English, meslin; that is, a mixture of wheat and rye. The proportions are not very exactly determined. If the land is more favourable to wheat than rye, more of wheat is sown in the mixture than of rye, and the contrary. It yields a good crop when sown after wheat, when wheat following wheat would not be

advisable. This culture is far from being universally approved in France; but some eminent farmers maintain that the crop is more sure than any other; that it is not easily lodged, and that neither the rye nor the wheat is so liable to rust or mildew as when cultivated alone. It sometimes happens, likewise, that the season is not favourable to one of the kinds of grain, when the other yields a crop. It follows potatoes to advantage. It is generally consumed on the farm, in preference to being sent to market; and it makes a healthy bread.

7. **Maize; Indian Corn.**—Indian corn (*Zea mays*), here often called Turkey wheat, for what reason I do not know, is cultivated to a considerable extent in the south, south-west, and south-east of France, and very much in various parts of Italy. In the richest soils in Italy it presented an extraordinary luxuriance, but nothing could be more slovenly than the cultivation of it, wherever I saw it.

The largest crops of which I could obtain information, were eighty bushels to an acre; but the ordinary yield was very much less than that, and indeed was quite small. The kinds cultivated were of the small yellow flint variety. The large kinds of gourd-seed corn grown in the southern states of the United States, or the kinds grown in the western states, an intermediate kind between the flint and the gourd seed, would find the climate and soil of southern Europe favourable, and might be introduced there to great advantake, if, in the present condition of society, they were capable of any great improvement. They are little accustomed to use it for bread, having no knowledge of the modes of mixing it with rye or wheat; but they use it as a kind of mush or pudding, called polenta. The expense of making it into food among the peasants is strongly objected to, as consuming both fuel and time. It is said that Napoleon used to lament that a labouring man, whether mechanic or peasant, should be accustomed to have a fire in his house for cooking; and the writer who records this fact, sympathizes strongly in this sentiment. That is to say, he would have all their food taken cold, and no time nor money expended in cooking.

I wonder if it never occurred to these men, what an improvement it would have been, if these labouring people, so troublesome and expensive as they are to be fed, and yet so useful and necessary as they are in growing all this bread, could have been turned out at night like the cattle after their yoke is taken off, to graze in the pasture. This would save bed and bedding, and house-rent, as well as food and cooking.

Such sentiments must sound rather harshly upon the ears of American farmers and labourers, who are accustomed, even in the humblest conditions, to sit down daily to a nicely spread table, covered with a variety and abundance of bread, meat, and vegetables, to which are often added tea, coffee, and beer. The diet of the labouring poor in Europe is chiefly bread; and this is almost always furnished by a professional baker. During my residence in Europe, I do not recollect a single instance where bread was made in the family. The want of fuel on the continent is a serious necessity. There are no labouring people who live in half the abundance of the labouring people of the United States.

I should extend my remarks much too far if I treated of many of the other smaller crops of the continent, which indeed present nothing remarkable; and in treating of Flemish husbandry, I shall have occasion to speak of several valuable plants which are cultivated in common by the two countries.

8. **Buckwheat.**—Buckwheat is grown very largely in poor soils in some parts of France, but it seems to be a mere shift

to live; and leaves only the regret, that land capable of a much better cultivation, should be thus appropriated.

9. Millet.—Millet is cultivated to some extent in parts of France, but almost exclusively for forage, and, in this respect, deserves much more attention than it usually receives. I wish my countrymen were more impressed with the extraordinary value of this plant. I know few plants which make a more abundant return, or which, when it is well cured, give a more nutritious forage, or one more relished by stock. On the intervale lands of the River Loire, where the crops are occasionally destroyed by an inundation, a crop of millet is obtained after the floods have passed off. The crop, under such circumstances, cannot be expected to be large, but it is obtained where no other would be.

10. Clover.—The common large red clover, known in France as the Spanish clover, is cultivated to a considerable extent in parts of France. It has been a long time cultivated in the Netherlands or Low Countries, but was not an established culture in France until about three quarters of a century ago. It is now considered as the foundation of good husbandry. Its foliage is abundant, and its large roots essentially enrich the land. It is sown in the spring, and its seed must not be buried deeply. The mode strongly recommended is to sow it on the wheat in the spring, immediately after the wheat is harrowed; and then to roll the wheat with a light roller.

It comes in in a regular course of rotation, but it is not allowed to occupy the land more than one or two years; and it is advised not to repeat it again under three years. Some English farmers object to its recurring even so often as this. The effects of plaster of Paris or gypsum sown upon it, either when the dew is upon it, or the air is humid, is as remarkable as in the United States, though beyond a certain amount it is of no avail. The efficiency or mode of operation of this extraordinary agent seems, as yet, wholly unexplained. The French farmers understand perfectly well the advantages of ploughing in a clover stubble as a preparation for grain of almost any kind: for lands which are not very rich, it is considered only as an aid, and not as a principal manure.

The small white clover, otherwise called the Dutch clover, constitutes an important element in the rich meadows and pastures of Holland. Clover is cultivated for its seed, in which case, the first crop is taken for forage, and the second for the seed. An eminent farmer speaks of his neighbours having refused to buy his clover-seed because his crop was small and thin; but, according to his own experiments with this seed, it was preferable to seed from a crop of more luxuriant growth. The probability is, that it was more mature.

Another species of clover, cultivated to a considerable extent, is the *trifolium incarnatum*, or scarlet clover, of which I have spoken in another place. This appears with a deep red flower, of a conical form and of extraordinary beauty. It endures for one year only.

11. LUCERNE.—Lucerne is cultivated very extensively in France, and, indeed, may be considered as their great dependence for green fodder. It is a general opinion that no plant will, in this respect, yield a greater return. Indian corn will yield more green food, but a crop of lucerne may be got much earlier. Three things are important in the culture of it; one, that the soil on which it is sown should be rich; second, that it should be deep, good in the subsoil as in the surface soil; and third, that it should be kept clean from weeds. On my visit to an admirably managed farm, about twenty miles from Paris, where every thing indicated the most exact care and attention, and which might almost be cited as a model farm, the farmer informed me that his lucerne, which he cultivated largely, was usually cut three

times, and gave him at the rate of fourteen tons to an hectare, made into hay. A French hectare is about two and a half acres, and this would be, therefore, a yield of more than five and a half tons to an acre. A dry season is particularly unfavourable to it. It requires a rich, but suffers from a wet soil.

Lucerne is sometimes sown among wheat or barley; but the most certain mode of securing it against weeds, is to plant it in narrow drills, and keep it clean by the hoe for a time, until it becomes well established. About eight pounds of seed, though this is deemed a large allowance, are sown to an acre. It will bear cutting three times a year, and will endure in the ground eight to ten years. It does not come to perfection the first year; and the circumstance of its being ordinarily continued in the ground for a term of years forms an objection to its culture, with those who wish to pursue a regular rotation of crops. Gypsum is applied to lucerne with the same success as to clover; and the best farmers advise to harrow it in the spring, and, indeed, after each cutting, excepting the last cutting in the autumn.

12. SAINFOIN.—Sainfoin is the next species of forage most largely cultivated in France. I have already spoken of it, but its value can scarcely be too highly appreciated. It is ordinarily cut only once a year, but in rare cases, twice. It forms a most excellent feed, especially for sheep; and the hay is of the best quality. It will endure for some years. They have had no success in cultivating sainfoin or lucerne in Flanders. The prejudice, to which I have referred, that it requires a calcareous soil, is, undoubtedly, not without some foundation.

I come now to speak of the great crops, which may be said to be almost peculiar to France; and if it be proper to estimate the agriculture of a country by the success of its peculiar crops, then the agriculture of France assumes a high rank. I refer in this case particularly to beet sugar, wine, silk, and oil and fruit from olives. These are in France immense products, and of high commercial value.

13. Beets. Beets for Sugar.—The history of the introduction of the culture of beets into France for the manufacture of sugar, is well known. The presence of sugar in the beet-root, in an available quantity, was the discovery of a distinguished chemist; and it is among the great obligations under which that science, cultivated so successfully, and with such distinguished talent, has laid the French. The Emperor Napoleon being cut off by the nations at war with him from those supplies of this article, which the people had been accustomed to receive from their colonies, conceived the plan of their supplying this great necessity from within themselves. It was much ridiculed, but he was not a man to be turned aside from any great project by any minor considerations, where success was possible: his object, to a considerable degree, was accomplished. Since his time, the culture and manufacture have been immensely extended, and it bids fair to prove one of the greatest boons that was ever bestowed on agriculture.

There are several kinds of beets cultivated, some of which have been cultivated for a long time. The common red or blood beet, ordinarily grown in gardens for the table, is a well known vegetable, not, I think, however, so highly appreciated in the United States as in England and on the Continent, where it is much eaten. I have known this cultivated with great success for cattle, adding largely to the product of cows in milk. This species, however, is never used for sugar.

The next is a very large kind, growing almost entirely out of the ground, of a pink colour and white flesh, known commonly as the scarcity beet, or mangel wurzel, attaining often a large size, and valuable for cattle. There are one or two other kinds, of a yellowish flesh, growing largely out of the ground, and which are considered even more nutritious for stock than the mangel wurzel.

The beet employed for sugar is called the Silesian beet, with a whitish skin and white flesh, but the most valuable kinds have a green neck and yellowish tint on the top. This is full as valuable for the feeding of animals as any of the others, and is decidedly the beet selected for its sugar properties. I have before me the chemical analysis of the properties of the beet-root, but I am unable to derive from them a single practical inference. It may be hoped, that chemistry will presently tell us what particular soil is best fitted to its growth, and what manure it peculiarly demands; but this service it has not yet performed. It grows best in a deep, rich, aluminous soil, not a sandy soil, not a calcareous soil, which is unfriendly to it; and it is particularly desirable that the soil should not be liable to suffer by excessive drought, so that vegetation is arrested. It will bear to be well manured, but it is not an extraordinary exhauster of the soil. It returns indeed a large amount of enriching matter to the soil in its abundant leaves.

The land should be well prepared, by being deeply dug or ploughed, and thoroughly manured, and the beets may be either sown, or planted in rows, of about twenty-seven inches apart, and the plants in the row about fourteen inches asunder. A great advantage comes from growing the plants in a nursery bed, and transplanting them. This gives a longer season for the preparation of the land, and the increase of labour in transplanting is compensated by the increased facility of keeping the cultivation clean. The largest crop of which I have obtained any information, was about forty-nine tons to an acre, and this was a case in which they had been transplanted. The ordinary crop does not exceed, and in many cases it falls short of, twenty-nine tons. The amount of seed required for an acre is not large, and every single seed produces four plants. A large proportion of the beet-root is water, and it is generally estimated that twenty pounds of hay are equal to one hundred pounds of crude beet. In transplanting, it is recommended, instead of doubling it up, to break off the lower end of the tap-root, and to plant it with a picker or a dibble.

In the culture of the beet, many persons have been in the habit of plucking the lower leaves for their stock, maintaining that the growth of the plant was not injured by this abrasion. Experiments fully establish the contrary. An experiment made in Belgium shows, that where beets, from which the leaves were not plucked, produced 925 baskets of roots, an equal part of the field, having been plucked once, produced 839 ; and another portion, which had been twice plucked in a season, produced only 539. The form in which this experiment is stated is not exact, as a basket itself is an uncertain measure, and the degree to which the plucking extended is not stated, but it seems decisive. The leaves, at the harvesting of the crop, furnish a large amount of forage. If left on the ground, they are reputed highly beneficial as manure, still more so if consumed by animals ; and cases are reported in which they have been closely packed away, where the air was effectually excluded, and have yielded a valuable forage for the winter.

That, exclusive of their sugar properties, they constitute a valuable green fodder for cows in milk, and fatting cattle, strongly recommends them to cultivation. They have this great advantage over turnips, that they give no disagreeable taste to the milk ; and that when in the spring, turnips have become corky, and potatoes sprout abundantly, and seem to lose in a great degree their nutritious properties, the beet preserves its freshness, even into June.

It is not within my province to go into the subject of the manufacture of sugar, farther than as it is connected with agriculture. The greatest profits are realized where an individual unites in himself the character of cultivator and manufacturer. The pulp that remains, after the sugar is expressed, is employed in the fatting of cattle and sheep. An eminent farmer, whose cultivation was of the finest description, and who manufactured a large amount of sugar, informed me, that he estimated his pulp, for the feeding of cattle and sheep, as constituting seven-twentieths of the whole value of the crop. It was in June, in that most beautiful agricultural country, French Flanders, when I visited him; and he was then using, and had large reservoirs of, the pulp from the manufacture of the preceding autumn. This he kept sweet and good in large vats, covered with sods and earth so as completely to exclude the air, and guard against a change of temperature. In his case, the beets were not rasped, but cut into small and thin slices by a machine, and then exposed to a hydrostatic pressure. Nothing could be finer than the samples of sugar which he showed me; and I admired, with great pleasure, the high condition of his sheep and cattle fed upon the pulp. He informed me that he obtained six per cent. of sugar from his beets. The chemists say that the beet contains twelve per cent. of saccharine matter, but the amount obtained does not ordinarily exceed five per cent. Whether this proceeds from the imperfection of the manufacture, farther inquiries may determine. In general, the farmers are not manufacturers, but sell their crude product to the large manufacturers in their vicinity. In such case, they usually make arrangements to receive back a portion of the expressed pulp. If otherwise, it would clearly be an exhausting process. It is mentioned, that the pulp constitutes a third of the weight of the crop. One hundred pounds of raw sugar gives seventy-five pounds of refined sugar, though it is stated that, by a recent discovered process, the sugar is bleached without being refined.

The gentleman to whom I have referred above, states that the manufacture of beet-sugar is at present a highly lucrative operation. At first, when the ports were closed to foreign sugars, prices were such, that even with imperfect modes of manufacture, the business yielded a large profit. Afterwards, when the sugar of the French West India colonies came into competition with it in the open market, the colonists found the competition too severe, and thinking themselves on the verge of ruin, they cried to the government for help and protection. The colonies of France were regarded as so important to its commerce and its navy, that the government laid a heavy impost upon domestic sugar. I believe governments never intermeddle directly in the control of human industry without doing somebody a harm; and excepting where allowed in some qualified cases as the rewards of inventive genius or skill, or as a security to the beneficial uses of capital, which otherwise could not be brought into use, monopolies of every kind combine all the elements of injustice. The effect of this impost was at once to ruin a large portion of the manufacturers of domestic sugar, and arrest the progress of a cultivation destined to exert the most beneficial influence upon the general interests of agriculture. The fixtures and establishments in different parts of the country fell into other hands, at a ruinous sacrifice to their original proprietors. The West India proprietors became more clamorous, for avarice was never yet satisfied with any concession, and the impost was still more increased. The elasticity of skill and genius have defied the pressure. Improved modes of manufacture have been discovered, by which more sugar is obtained from the same amount of the raw material, and obtained at a cheaper rate; and in spite of the heavy imposts the manufacture is highly profitable, especially to those persons who bought already made to their hands the old manufacturing establishments.

In 1842, the production of beet-sugar in France reached the enormous amount of 67,717,685 lbs. It had in some years, as it must evidently vary with the seasons, been even more than this; and there is no reason to suppose that it has decreased. In some parts of the country I have seen several factories of recent erection. When the value of the leaves and the pulp for the fatting of animals is added to this actual creation of wealth out of the earth; when the wages received by the innumerable persons employed in the culture of the plant, and the fabrication and refinement of the sugar, are also taken into view; when the admirable preparation which this culture makes for the succeeding crops; when its beneficial influences upon the commerce of the country are considered; and when especially the whole is regarded as the product of healthy, well-requited, and free labour, and without even the smallest expense or hazard to human life or comfort, it is impossible to exaggerate the value of this great and increasing product.

A highly distinguished agriculturist in France, perhaps as competent as any man to speak on this subject, has recently given to the public a statement in regard to it, which must attract particular attention. I shall give his statement nearly in his own words. A hectare (about two and a half acres) produces in the Isle of Bourbon about 76,000 kilograms (a kilogram is about two pounds and a fifth of a pound) of cane, which will give 9200 kilograms of sugar, and which costs in labour 2500 francs. A hectare of beet-root produces 40,000 kilograms of roots, which will produce 2400 kilograms of sugar, and the expense of the culture of which costs 354 francs. The cost of the cane sugar in this case is 27 centimes, and of the beet-sugar 14 centimes only, per kilogram[1]. These are extraordinary statements, and will be looked at by the political economist and the philanthropist with great interest. There are few of the northern states of Europe, or of the United States, which might not produce their own sugar; and when we take into account the value of this product, even in its remains after the sugar is extracted, for the fatting of cattle and sheep, and of course for the enrichment of the land for succeeding crops, its important bearing upon agricultural improvement cannot be exaggerated.

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[1] "According to M. Peligot, the average amount of sugar in beets is twelve per cent.; but by extraction they obtain only about five per cent. The cane contains about eighteen per cent. of saccharine matter, but they get only about seven and a half. The expense of cultivating an hectare of beets, according to Dombasle, is 354 francs. An hectare of cane, which produces 2200 kilograms of sugar in the Isle of Bourbon, and only 2000 in French Guiana, demands the labour of twelve negroes, the annual expense of each of whom is 250 francs, according to M. Labran."—Commission of Inquiry in 1840.

The production of beet-sugar is not by any means confined to France. Large amounts are produced in Belgium, where I found most extensive manufactories, and in several parts of Germany; but in none of these countries is industry in any form unrestricted; and a man hardly dares to be successful in any enterprise, at least to proclaim his success, lest the government by some impost or taxation should endeavour to avail itself of his success for its own advantages. It is thus that every where industry is checked and hampered, and enterprise scarcely rises from the ground, but is seen fluttering along upon one wing.

14. SILK.—Silk is another large product in France, giving a humble but honest living to thousands and hundreds of thousands. Its production is greatly on the increase; and the last year is reported to have nearly doubled itself.

I know nothing so remarkable in all its pecuniary and useful results as the product of this humble insect, the silk-worm, whose whole term of being is limited to five weeks. Nothing is to be compared with it in the perfection and beauty of the fabrications of which it supplies the material and basis. What man, woman, or child's dress in any civilized community is not in some measure indebted to the labours of this humble insect? and its bearing in a commercial view is an immense affair. In its pecuniary results, with the exception of the article of bread, few things come in competition with it.

It is not merely the value of the product as it comes from the insect which gives it importance, but the extraordinary amount of industry and commerce which his humble labours set in motion. In France, as in other old and populous countries, every branch of industry is divided and minutely subdivided. There is in the first place the grower of the mulberry-trees, who does not always connect with this pursuit the production of silk; but the leaves of his trees are sold in the market as any other forage would be. To him succeeds the grower, or, as he is commonly called, the educator of the silk-worms, who hatches, feeds, and manages the worms until their task is completed, and the cocoons are ready for the market. He is succeeded by the filator, or winder, of the silk from the cocoons, who prepares the crude or raw silk for the manufacturer. Here another and numerous class of operatives is set in motion; the spinner, the weaver, the dyer, the pattern-former, the machinist, and the master manufacturer, from whose hands it proceeds next into the hands of the wholesale dealer, and thence into the hands of the retail dealer, to say nothing of the various forms which it afterwards assumes under the agency of modists, dress-makers, furniture-makers, hat-makers, and the almost countless operations and transformations which it has to pass through in the various objects and forms of which it constitutes a part. Indeed, it would be difficult to name any single article which plays a more important part in an industrial, economical, and commercial view.

The earliest production of silk is attributed to the Chinese, but the particular date of its origin is lost in the obscurity of remote history. There are many other worms which, in the curious transformations through which they pass, involve themselves, preparatory to their emerging into a new form of being, in a cocoon formed of the finest tissue. But it is the silk-worm, or, as he is sometimes called, the mulberry-worm, alone which furnishes a material of sufficient firmness to be converted into cloth.

The production of silk in France is now carried to a great extent. Four years ago it was estimated at 1,200,000 kilograms, or about 2,240,000 pounds of raw silk per annum. The last year it was reported to have doubled itself, but, if this should be an exaggerated statement, the production may yet be set down as having vastly increased; and, in a peaceful condition of the country, is likely still more to extend itself. It affords the means of living to many persons, who must otherwise be without resource. In many parts of this culture, the hands of children avail as much as those of men and women, and thus the industry of whole families is set in motion.

The silk-culture has generally been considered as limited to a hot climate, and some have maintained that it belonged exclusively to countries in which the vine could be successfully cultivated. The silk made in temperate climates, and even in the mountainous parts of hot countries, where the temperature is moderate, is esteemed better than that produced in very hot countries. It is difficult to prescribe the exact limits of this production. The mulberry will grow in very high latitudes; but in such cases, it is liable to be killed by the severe frosts of winter; and it is indispensable that the season should be long enough, after the first defoliation, for the mulberry-tree to renew and perfect its leaves. The worms require a mild and temperate climate; for though they have been grown or reared in rooms where the temperature is, properly speaking, artificial, yet the expense and trouble attending such arrangements are a serious abatement of the profits, added to the difficulties of managing such a temperature, and the risks to the lives and health of the worms. It is important to make every effort to keep down the expenses of the culture.

The mulberry may be considered as the only proper food of the silk-worm. Various substitutes have been proposed by the Chinese and others, but wholly without success. The worms may be induced to eat, and may be kept alive upon other substances, but they will make no silk. The Chinese have moistened the leaves, and sprinkled them with powdered rice, chicory, and peas, and with the powder of the dried mulberry leaves, so that the worms, in getting at the leaves, were compelled to eat of the powder, but it has been without advantage.

The mulberry is not a tree of difficult cultivation; but, like most other things, it makes a full compensation for particular care and attention. It will grow upon a poor, but it will flourish only on a good soil, inclined to sand, and not humid or heavy. It is advised to train these trees with an open head, that the foliage may be accessible to light and air, and not to feed from them until they are full three years old. The leaves must not be taken from them more than once in a year, and it is desirable to forward the first defoliation, so that the second growth of leaves may become quite matured. Mulberry-trees are set out as ornamental trees by the sides of roads, and in the neighbourhood of houses; or, where the business is pursued on an extensive scale, they are planted in rows at a few yards' distance, as is customary with our apple orchards. In many parts of Italy, in Lombardy and Tuscany, the vines are trained to hang in graceful festoons from one tree to another; and when the rich clusters of grapes are seen among the green foliage, it would be difficult to find any thing of the kind more beautiful. An hectare of arable or meadow land in France, may be valued at 2000 to 5000 francs, or say, 400 to 1000 dollars; an hectare of mulberry-trees in the same locality would, in such case, be valued at 5000 to 12,000 francs, or from 1000 to 2400 dollars. It is calculated that an hectare (about two and a half acres) of mulberry-trees, in full bearing, will produce sufficient foliage to supply the wants of the worms produced by ten ounces of eggs. This would give a product of about 22,000 pounds of leaves.

The mulberry may be propagated by sowing the seed, by engrafting, or by layers; the two latter modes are of course the only certain modes of securing the best kinds. The principal kinds propagated in France are four; but they differ somewhat in their product, as the experiments of one of the first cultivators of silk in France, with whom I have the pleasure of an acquaintance, seem to show. What appears to be wanted in a mulberry leaf (excepting for the worms in their first age) is a leaf of a good deal of thickness and weight. The four principal mulberry-trees cultivated in France are:—

Le mûrier rose, or the rose-leaved mulberry.

Le mûrier multicaule, or the multicaulis, well known in the United States.

Le mûrier Moretti, a mulberry, which takes its name from a physician who first produced it.

Le mûrier sauvageon, or wild mulberry, which is our common white mulberry.

The multicaulis is condemned in France in the strongest manner. It is of very easy cultivation; it yields a great deal of foliage; it produces a fair quantity of silk; but it is considered too watery, and to create disease among the worms. One of the most eminent silk-culturists in France denounced it to me in no measured terms. The rose mulberry is upon the whole pronounced superior to all others. Its leaves have too much thickness and strength for the worms in their first age; but in such case it is necessary to select the youngest and most tender leaves, and to moisten them with water. The leaves of the common wild mulberry are complained of, as fading rapidly after being gathered, and becoming too soon unfit for use. The time for hatching the worms should correspond as nearly as possible with the condition of the leaves, taking care that the leaves should be considerably advanced, as the consumption of them in too young a state is necessarily wasteful. Experiments have been made to test the comparative value of the different mulberry leaves in the production of silk—I refer to its quality and quantity; but though conducted with much care, they do not appear to lead to any important practical results.

The difference in the worms deserves attention, some producing a large, and others a smaller, cocoon ; and some giving consequently a larger return in silk than others. This difference is considerable, some producing from a certain weight of cocoons ten or twelve per cent., and others eighteen per cent. of silk. The great division of races is, into those which produce a white, and those which produce a yellow, cocoon. It is said that different races of the worm are suited to different climates, either hot or temperate ; and the results are always more or less affected by the mode of feeding and the care bestowed upon them.

The principal of the white races of worms is called the Sina, and this species produces a very fine and beautiful silk. This species was imported from China almost a century since ; and its excellence has been maintained, and indeed it is represented to be much improved by care and selection. The silk of this species of worm is employed for making the very finest of the white silk fabrics. Ten to twelve pounds of the cocoons produce one pound of silk. The cocoons are cylindrical, round at the ends, with a depression or cincture round the middle.

The principal of the yellow races is the Turin. This is known in Italy by several different names. The form of the cocoon is cylindrical, with a deep indenture or cincture round the middle, the ends are round, and the colour is a beautiful yellow. They are esteemed as among the best cocoons known, and furnish a very strong silk.

The Cora is another celebrated race, which is reported to have been the result of a cross between two of the most beautiful and rich of the yellow races, the Turin and the Loudun. This species yields a large return of silk in proportion to the weight of the cocoons ; the cocoons are much sought after, and sell at a higher price than any of the common kinds. As my limits allow me only to refer to the best kinds, I shall not enumerate others, of which there are several sorts, more or less esteemed in different localities.

The ordinary life of a silk-worm embraces five ages, or four important changes. There is a species called the three-change worms; but this peculiarity is considered as the result of a diseased constitution, and the product is comparatively worthless. The worms, by extraordinary feeding, may be forced to finish their feeding in some cases in eighteen days; but this at the expense of a great deal of trouble, and generally at the risk of disease. Their feeding is in some cases extended to fifty days; but this is always owing to scanty and illiberal feeding, and the product is sure to be inferior. The period most to be desired, in which to complete their feeding, is twenty-eight or thirty days. This is supposed to depend somewhat upon the peculiar constitution of the race of worms which are fed, but more upon the feeding and management. It is earnestly pressed upon the cultivators to commence the hatching of the eggs as early in the season as the condition of the mulberry leaves will allow it to be done with a certainty of a supply of food. The hatching of the eggs should be artificially forced, in order, as far as possible, to be contemporaneous, as where it is left to take place naturally, there will be a difference in the time of hatching among the worms of several days, which is an inconvenience to be anxiously avoided. It is recommended in the three first ages to cut the leaves fine, and for the very young worms in the first stage, they should be sifted. In order to success, the worms must not be neglected by day or night. In the first age they require twelve feedings in the twenty-four hours; in the fourth age, eight or ten; in the fifth age, seven or eight. The feedings should, in fact, be multiplied as much as possible; as where, with a view of saving time or labour, the food of three or four times is given at once, the worms become disgusted, and lose their appetite; a great deal of forage is lost;

and bad results are likely to follow. As overfeeding is injurious, so is fasting equally injurious. In order to ensure success, no neglect must be tolerated. Cleanliness in every department is especially important. The worms must not be crowded. They must likewise be occasionally assorted, placing together those whose progress and condition are most nearly alike; and especially removing at once the feeble and diseased. The best preparation for their mounting, when their cocoon is to be formed, may be termed a small twig broom, inverted and placed so that the upper part may be spread between the shelves on which the worms are fed. The cocoons after they are completed, reserving those only which are designed for the continuance of the race, are placed for the destruction of the chrysalis in steam, as being the most certain and effectual mode. The cocoons being completed, and the poor tenant of this silken abode strangled in his own habitation, now pass into other hands for the winding of the silk.

In many parts of Europe, among those who cultivate the silk-worm upon a small scale, some vacant room in the house is occupied for the worms, and very often some vacant barn or building is used for this purpose at a season of the year when it is not occupied for other purposes. Where silk is cultivated on an extensive scale, a building is erected for the special purpose of raising the worms, called a magnanerie. The size of this building is of course to be proportioned to the quantity of worms to be raised; and the quantity of worms to be raised must be proportioned to the amount of food to be obtained. Great losses are sometimes incurred by a miscalculation in respect either to the forage or the worms. It is of great moment not to err on the side of too little provision for the feed of the worms, who in their last age consume with almost incredible voracity. Few things are more prejudicial to success than a deficiency of food, or subjecting the worms to fasting.

The magnanerie must in the first place supply ample room for the worms: they must not be crowded. It requires a separate room for the hatching of the worms and their feeding during the first age. It must be furnished with sufficient means for heating the apartments in which they are kept. It must have the means of complete ventilation, without bringing draughts of cold air directly upon them. It must be capable of being closed or opened at pleasure, in order to regulate the temperature, which is of great moment. It must be light also, and be capable of being lighted in the evening; for they like the light, and if success is looked for they are not to be neglected either by day or night.

It has been supposed that the silk-worms are injuriously affected by noise; but this is now deemed an error, as no organs of hearing have been discovered. They are injuriously affected by noxious odours, and this must be guarded against. They are likewise much affected by changes of temperature, and especially by a close and confined atmosphere. The former may to a certain extent be regulated by artificial means, and the latter by ventilation. The tables on which the worms are placed, may be made of canvass on an endless roller, and the worms being induced by fresh leaves to rise upon a netting made of twine set in a frame, may be lifted up, and by turning the canvass, the litter may be easily removed, and the worms replaced. The legs of the tables on which the worms are fed, should be set in water, so as to prevent the access of ants, which are destructive to them; and every pains must be taken to keep off birds, rats, and mice, which have no hesitation in destroying these industrious creatures.

There are several serious diseases to which the worms are subject, and some of a fatal character. They are supposed in general to owe their origin to neglect, to insufficient or irregular feeding, to want of ventilation, to neglect of cleanliness, or to too much crowding. The disease called the *mus-*

cardine is of all others the most dreaded, as it is contagious and generally fatal. The causes of it have not yet been ascertained, and no effectual remedy has been discovered. If it is not caused by neglect, yet the only hope of preventing it is by the most attentive and exemplary care. Where it has once prevailed, it is liable to re-appear; and in such places it is advised as the only certain preventive to suspend for a time the raising of the worms. It shows itself at all ages of the worms. A large premium has been offered by the Agricultural Society of France for the discovery of an effectual remedy or preventive; but as yet without success. The worms are often injuriously affected by thunder-storms or a highly electrical atmosphere; but no human skill affords any protection against this.

Many experiments have been made to get two crops of worms and silk in a season; but by the most experienced feeders such attempts are entirely disapproved. I shall not attempt any calculation of expenses or profits, these must so vary in different places from the difference in the cost of labour and of land. First, it may be said of the silk culture that the principal labour which it requires occurs at a season when other agricultural operations are not of a pressing character, and the season is one of comparative leisure. In the next place, the farm-buildings, which may be occupied where the climate admits of it as a magnanerie, are likely to be vacant, preparatory to receiving the crops. Next, the trees being once planted and matured, and the magnanerie established, they require but little care to preserve them in condition, and a large portion of the expense is incurred. In the last place, the work is of a character to give healthful, useful, and interesting employment to the younger and female parts of a family, whose expenses are sure to go on, but whose labour, for want of some such occupation, might otherwise be lost. The article when produced is imperishable, and at present may be considered as sure of a market.

I have only noted the outlines of the subject. I must not go more into detail; but the whole process is simple and intelligible, and the details are easily attainable. There is no extraordinary ingenuity in the apparatus or machines connected either with the management of the worms or the unwinding of the cocoons; but I found with Mr. Robinet, of Paris, who has distinguished himself by his attention to this subject, a small and ingenious machine for testing the strength of the raw silk. There was a graduated index at the back of the machine; a strong pressure was made on two threads of the silk suspended from the top of the index, and the degree of pressure or tension required to break the thread indicated of course its actual strength.

I can hardly quit this subject without calling upon my readers to admire with me the wonderful products of this humble animal. The pecuniary value of the product is enormous; its utility is unquestioned and universal; the amount of industry which it sets in motion is immense; and the splendour and beauty of the fabrications, of which it forms the *materiel*, are unsurpassed.

15. THE VINE.—The next great agricultural product of France is that of the vine. The whole extent of land cultivated in vines in France by the last returns was 4,929,950 acres; and there is reason to believe that this amount has been considerably increased since those returns were obtained. The total value of the vine crop in France, reckoning seven gallons of wine as required to supply one gallon of brandy, is estimated at 59,059,150 francs, or, in round numbers, 11,811,830 dollars, or 2,362,366*l.* sterling. It is supposed that six-tenths of the wine produced are consumed in France; the remainder forms the subject of a lucrative commerce.

In a moral view, one would at first be inclined to dread the effects of such a production upon the habits of the people. It would not be true to say there is no drunkenness in France; but, account for it as we will, temperance is pre-eminently the characteristic of the French people, and I believe them to be without question the most sober of all civilized countries. In the rural districts, wine is the ordinary drink; but this is not in itself a strong wine, and is almost invariably diluted with water. Much complaint has been made that such immense tracts of land are devoted to the production of wine instead of bread; but, in many of the bread-growing countries, a far larger proportion in value of the product has been devoted to the manufacture of a drink far more intoxicating, and much more fatal to peace, public order, domestic happiness, and all good morals, than the mild and ordinary wines of France; which, when unadulterated, are the pure juice of the grape, and have not the strength of common cider. I was in the vine-growing countries in the season of the vintage, when wine in the greatest abundance was free to all, but there was no more excess than at any other season. We could hardly expect these laborious people, whose chief solid subsistence is bread, to limit themselves to water, and we could not but feel grateful that God had given them so innocent and delicious a beverage to cheer and sustain them under their toil. It is not the use but the abuse of these gifts of Heaven, which constitutes the criminality, and converts them into a fatal poison.

Various attempts have been made in different periods to limit the cultivation of the vine. In one case, after a severe scarcity, one of the Roman monarchs ordered the whole of the vines in certain provinces to be destroyed, and more than half the vines in other provinces; and several kings of France have prohibited the occupation of land beyond a certain amount in the culture of the vine, that the people might be compelled to the cultivation of bread. Such interference on the part of governments in private concerns, and such arbitrary measures, seldom effect the desired end. The culture of the bread-grains, is, unquestionably, always of the first importance; but arrangements of this kind are generally much better left to private interest than to public control. The principal objection to the culture of the vine is, that it is in no respect subsidiary to any other crop; that it occupies the land permanently, without permitting any other crop; and that the vines require much manuring, though they do not always get it, without furnishing the materials for producing any manure. Some persons have ploughed or dug in the cuttings and waste parts of the vine, and it is said with extraordinary success, but the practice is not much extended.

The vines are ordinarily raised from cuttings in a nursery, and transplanted at one year old, generally in rows about four feet asunder each way; but farther when it is intended to plough between them. Generally the land is dug with a spade; the old wood cut away in the spring, and the new trimmed, leaving three buds only. They are then staked, and trained to these stakes, which are from four to five feet in height. At the harvest they are gathered with great adroitness, the clusters being cut with a knife or scissors, and carried to the pressing-house in casks or carts. The whole process, afterwards, resembles precisely the manufacture of cider, excepting that I saw no straw used in laying up what is called the cheese, the stems of the vines supplying the place of straw, in giving compactness to the heap; and that there is no breaking or crushing of the grapes as of the apples, before they are put under the press. The juice, as it comes from the grape, is always white, but it is coloured by leaving the stems and skins of the grapes in the vat with the liquor twenty-four hours after it is expressed. The after-management of the wine, where it is kept pure, consists in straining, and different drawings off and bottling, very much like the management of the best cider; above all things, watching over the casks to preserve them from must or any offensive substance.

The different kinds of wine take their names from the different countries or vineyards in which they are produced. I cannot persuade myself that the grape itself has not much to do with the quality of the wine; but the constant reply to my inquiries was, that the character of the wine depended mainly upon the particular locality in which it was grown, upon some peculiarity in the aspect, or some unknown quality of the soil. I have no doubt the particular quality of the grape has its full share, and other circumstances besides those which I have enumerated. The adulteration of wines, their mixture, and their fabrication out of materials wholly foreign from the grape, are carried on, undoubtedly, to a great extent; especially in the cities, as, indeed, in what country are not such adulterations more or less prevalent, as the condition of the market may render them profitable?

In France the appearance of a vineyard presents nothing very picturesque, though in the season of harvest it is extremely rich, as I have travelled for miles and miles through vineyards loaded with this delicious fruit. The fields in France are very rarely separated by fences or ditches; but many facts have come to my knowledge, and some within my own personal observation, which convinced me that no where are the rights of property more scrupulously respected. In Italy especially, in the fertile plains of Lombardy, the vines are trained from tree to tree, sometimes covering a whole tree with their thick and umbrageous foliage; and the purple clusters of the fruit, hanging over the tree in the richest abundance, remind one of some of the earliest temptations to which our frail race are said to have been subjected.

In passing up the Rhine, after entering upon the highlands, the base of which the waves of this magnificent river have swept for so many ages, one is absolutely struck with amazement at the examples of industry, labour, and enterprise which every where present themselves, in the cultivation of the vine, wherever a favourable aspect presents itself. The steepest acclivities are walled up in successive steps or zigzag lines, from the bottom to the top of very high hills, so as to create or obtain some little flat surface for the planting of the vines, and to prevent the washing of the dirt from their roots. Where there is no soil, soil has been transported on the shoulders of men and women in baskets, for no horse or mule could possibly ascend many of these heights; and where there has been no other method of securing the soil and the vine, these baskets full of soil have been placed, and there remain, that the plant may have a footing. The manure, too, to supply these vines, must be carried up, and the produce must all be brought down upon human shoulders. The labour performed here seems almost incredible. The German wines bear a high price, and these situations produce those of the best quality. The celebrated Johannisberg wine is grown upon the banks of the Rhine, at a magnificent place owned by the distinguished Prince Metternich, and is said to be a source of great profit. The delighted traveller has the opportunity of at least feasting his eyes on this beautiful vineyard, and this rich and picturesque country.

A vineyard, if well cared for, will last an indefinite number of years. The worst wines grown in France are represented to be the most profitable, as they pay either none, or the lightest duties, and being sold at a cheap rate, they never want consumers.

16. OLIVES.—The cultivation of the olive-tree, both for comfits or pickles, and for the oil obtained from the fruit, is considerably extended in France, and still more in Southern Italy. The extent of land appropriated to the growth of the olive in France is stated to be about 303,000 acres. The culture is limited to the southern portions of France, as the tree does not endure any considerable degree of cold. The money value of the product in France is estimated at

22,776,398 francs, or 4,555,279 dollars, for sale; and the value of that which is consumed is reckoned at 23,102,841 francs, or 4,620,568 dollars, or 1,835,169*l.* sterling. This is a great product for a permanent article. The oil-cakes left after the expression of the oil are considered as very valuable for cattle, and their value defrays some portion of the expense of expressing the oil.

The olive groves or orchards in Southern Italy are very extensive. Looking out from the high grounds in the neighbourhood of Florence upon the enchanting valley of the Arno, it appears like an almost uninterrupted grove of olives as far as the eye can reach. It is difficult to conceive of a richer, more beautiful, or more picturesque landscape than is here spread before the eye; combining a charmingly varied surface, with cities crowning the summits, and white palaces glittering among the richest foliage, the river winding its gentle and silver stream through the whole length of the valley, amidst forests and fields of the deepest and most luxuriant vegetation.

The olive-trees are of long endurance. I was shown some orchards to which tradition ascribes an age of eight hundred years; the condition, however, either from age or neglect, was not flourishing. More than a hundred different kinds of olive-trees are mentioned in France, differing in the quality of their product, and in their adaptation to different soils and temperature. New varieties are occasionally produced by sowing the seed in nurseries. The trees are planted in squares in the fields, at the distance of five or six yards apart, more or less, according as the soil is dry or humid, nearer to each other in the former case than in the latter. The trees should be well manured either with stable manure or compost; it is advised to dig round the trees every spring and autumn. The field should be cultivated, taking care to guard against injury to the roots, with the plough; and, if grain is sown, the portion near the roots of the trees should be dug in while green, and before the grain is formed.

The great enemies of the olive-trees are the cold and certain insects. The severe cold in 1820 and 1836 destroyed a great many trees in France. Many insects infest the trees, which sometimes prove destructive, against which remedies are prescribed like those employed against the insects which infest the apple-trees. How far it might be successful to introduce the cultivation of the olive-tree into the southern states of the United States, I must, after the above account, leave the parties interested to judge.

The fig was growing freely in Italy in the open air, and by the road side.

CXXV. GENERAL VIEWS OF FRENCH AGRICULTURE.

I have now gone over the principal crops produced in France, with the exception of some which will come under review in treating of the husbandry of Flanders, where these crops are grown with more skill and success than in France.

I think my readers will have reached a conclusion to which I early arrived, which is, that the agriculture or husbandry of France is a subject of much greater importance, and conducted with much more skill than is generally thought. There are several subjects connected with it upon which I shall speak hereafter. In many parts, I may add in large parts of the country, the cultivation is inferior, negligent, and extremely discreditable. France, however, is not the only country to which these remarks apply; but it must be said of France, that in some of their principal crops, those to which their climate is adapted, to which they have been habituated, and which they have found to yield the largest profit, no persons have advanced further than they. I instance only the production of beet-sugar, which must be taken in connexion with the residue or refuse of the manufacture, furnishing so rich and useful an aliment for cattle and sheep. This production is enormous, and constantly increasing; next, the production of silk, which furnishes so valuable and simple a resource for the poor, and which, followed out in its various ramifications, will be found to set so many thousands, nay hundreds of thousands, of industrious hands in motion; and lastly, its production of wine, so important an article of domestic consumption, and so large an article of commerce. I am not of opinion that perfection has been reached in either of these articles of culture,—for to what that is human does that term perfection, in any but the most qualified sense, apply?—but certainly the culture of these articles is pursued with the most exemplary diligence and enterprise; I may add, with as much diligence, and enterprise, and success, as are applied in any cultivation in any country.

CXXVI. FARM NEAR VERSAILLES.

I shall hereafter recur to the subject of the agriculture of France; but I may in this place say, that I have met examples of farming in France, which for excellence of culture and arrangement, and the success of the farming, are no where within my knowledge exceeded. A farm in the neighbourhood of Versailles, with the intelligent proprietor of which I had the pleasure of an intimate acquaintance, in its excellent management may be considered as a model farm. It consists of about 700 acres. The husbandry is of a mixed kind; a large milking stock is kept on the farm, which though not reared on the farm, are very carefully selected; and kept and fed in well-arranged and capacious stables, where the best arrangements by gutters and cisterns are made for collecting and saving all the liquid as well as all the solid manure. Abundant crops of lucerne are grown both for green feeding and hay, and likewise of sainfoin. Good crops of wheat are likewise raised, and of colza. Carrots are cultivated extensively for the stock; and potatoes especially for the manufacture of starch. This manufacture, very simple in its character, constitutes a large object of attention; and what with the potatoes grown upon the place, and those which are purchased, more than one hundred thousand bushels are used in this manufacture in the course of the year. The refuse water or liquor from this fabrication is first collected in tanks or open reservoirs, where it makes a considerable deposit from the matter still floating in it. The liquid portions are conveyed by small channels or canals on to the grass-fields, which are thus irrigated, and the solid portions are taken out and spread. The effect of this manure is extremely beneficial, and it scarcely differs in strength from the best animal or stable manure.

CXXVII. FARM ACCOUNTS.

At no place have I seen a more complete system of farm accounts than at this farm. The books are kept with the greatest accuracy; so that the result is seen at once, and any specific loss or gain is traced to its proper source. Through the kindness of the owner, I was enabled to procure a form of these accounts. I subjoin it, thinking I can give few things of the kind more valuable to my readers. The great and almost universal fault of farmers is, that through ignorance or neglect they can hardly be said to keep any accounts;

sometimes merely a few memoranda in an interleaved almanack, or a few chalks behind the door; or if they keep books, they are often confused, are seldom balanced, and the farmer never arrives at a result upon which he can rely. Often under these circumstances he finds himself gradually declining into hopeless bankruptcy, without being able to ascertain the most active and certain causes. The ship is filling, but he cannot detect the leak, nor consequently the means of stopping it. He may call all hands to work day and night at the pumps, but with little hope of saving the vessel until the fatal inlet is discovered, and that may prove too late.

Under the system adopted by this excellent farmer, an account is kept with every crop, with the stable, the cow-house, the sheep-fold, the poultry-yard, the labourers, and the farm-house. Each is regularly charged with every item on the debit-side, and credited with every return which it makes. The whole is then brought into a general *résumé;* an account of stock is taken; and the books balanced once a year with the accuracy of a banker's clerk.

Take for example his Winter Wheat: it is charged with

Ploughing, harrowing, and rolling.
Manures.
Seed.
Reaping, and binding, and stacking.
Threshing, measuring, and storing.
Transporting and marketing.
Rent of land.
Total of expenses.
Expense per acre.

In other columns are arranged

The extent of the land in wheat.
Product in grain and in straw.
Product by the acre.
Value of the grain and of the straw.
Total value of the product.
Value per acre.
Profit of the cultivation,
or
Loss.

The account of each crop is kept in this form in a book ruled in separate columns for this purpose. The history of the crop, such as the time of sowing and of reaping, is given at the bottom of the page; and the average yield of the crop for the ten preceding years.

The account of the Stable is kept in this form:

Expenses.	Credits to the Stable.
Feeding of the horses.	Labours upon the Farm — Ploughing, &c.
Utensils and furniture for the stables.	
Equipages—Harnesses, saddlery.	— Upon the road.
Carriages.	Manure.
Farriery.	——
Waggoners and Ostlers—Wages and expenses on the road.	Profit or loss.
Board of waggoners and ostlers.	
Extraordinary expenses.	

The expenses of the Sheep-fold are kept as follows. The account opens with the 1st of July, and finishes with the 30th of June:—

Account is taken of the number of

- Flocks.
- Sheep.
- Lambs.
- Rams.

A second column gives the account of purchases; and another of sales, during the year.

A fourth column gives the number of flocks, sheep, lambs, and rams, at the end of the year.

The next chapter embraces the several items of expense, such as—

- Cost of feed.
- Medicines or drugs.
- Driving and folding.
- Hurdles, troughs, &c.
- Transporting and expenses of marketing.
- Shepherds—their wages.
- " " board.
- Straw for litter.
- Total of expenses.

Other columns give the estimated value of the flock at the beginning and close of the year.

Returns from the sale of sheep.
" " wool and skins.
" the value of manure.
" the benefit from folding.
——
Profit or loss.

The account of the Cow or Milk establishment is kept in the same form:—

Keeping of the cows.
Cost of cows.
Care of them.
Utensils.
Expense of the sale of milk.
Litter for the stables.

Number of cows, and their value at the beginning of the year.
Expense of cows purchased.
Number of calves.
Returns from milk or butter sold.
„ from calves.
Value of manure.

The Poultry-yard, embracing also the Pigs, is brought under a similar supervision, and the accounts of the whole year, in expenses and returns, are carefully preserved and adjusted.

The account of Manures is likewise kept:—thus,

Manures purchased.
Transportation of manure.
Straw for litter.

Loading and unloading.
Spreading.
Oil-cakes purchased

Compost heaps.
Folding.

The general expenses of the Farm are then brought into the account:—

Overseers and their travelling expenses.
Bookkeeper, stationery, and postage.
Wages and clothing for the servants.
Journeyings, hunting, dogs.
Time of horse for service of the family.
Insurance against fire and hail.
Taxes.
Utensils and furniture.

Wood and cutting fuel.
Measuring ground.
Mole and rat catcher.
Workmen, by the day or task.
Expense of waggons and farriery.
Saddlery and harness.
Bedding and linen.
Painter, glazier, carpenter, blacksmith, ironmonger.

The specific expenses of the household are next brought into account:—

Kitchen expenses.
Cellar.
Eatables.
Groceries.
Butcher.
Baker.
Wood and charcoal.
Household and kitchen furniture.

Beer.
Products of the farm consumed, such as milk and cream, eggs, poultry, mutton, pork, potatoes, fruits and vegetables, butter, and cheese.
Presents to servants.
New Year's and Christmas gifts.
Care and medicine in sickness.

Miscellaneous expenses follow:—

For the poor, charitable gifts.
Education of poor children.

Meat, bread, wood, medicine, boarding, clothing, fruits and vegetables.

Expenses:—

Civic charges at the mayory.
To the police-officers, or country watch.
For a public engine and carriage to protect against fire.

I have thus given the items of accounts kept on this excellently-managed estate, not so much to recommend the precise form in which they are kept, as to show their particularity and exactness. The great value of this extreme precision is, that the owner is at once enabled to discover what are the particular sources or occasions of expense, and to determine, if it should be necessary or expedient, what he may at once retrench or forego. The keeping of such accounts requires time and care, and, perhaps, in this case, they may be too much extended. But a careful and orderly arrangement, together with punctuality and exactness, so that the work may never get into confusion or arrears, will overcome much of the difficulty. The satisfaction and advantages arising from it, will be a full compensation for the labour and expense which it may require. I cannot understand why on a large farm a bookkeeper should not be kept as much as in any shop or other trading concern.

I only add, that I have the results of the accounts of this farm from 1816 to 1846, thirty years; that the receipts vary considerably as products and prices vary; but that, in not more than three years in the thirty, was there any loss, and in the other cases a fair and reasonable gain.

CXXVIII. AGRICULTURE OF BELGIUM AND HOLLAND.

I pass now to the agriculture of Belgium or Flanders. My remarks will embrace the whole of the Low Countries, Holland as well as Flanders. Though they differ in many particulars, yet they may be considered together. I entered these beautiful countries, beautiful in the eye of an agriculturist from the richness of their crops, and the perfection of their cultivation, in the month of June; and I confess my expectations, excited as they were, were more than answered.

CXXIX. THE SOIL.

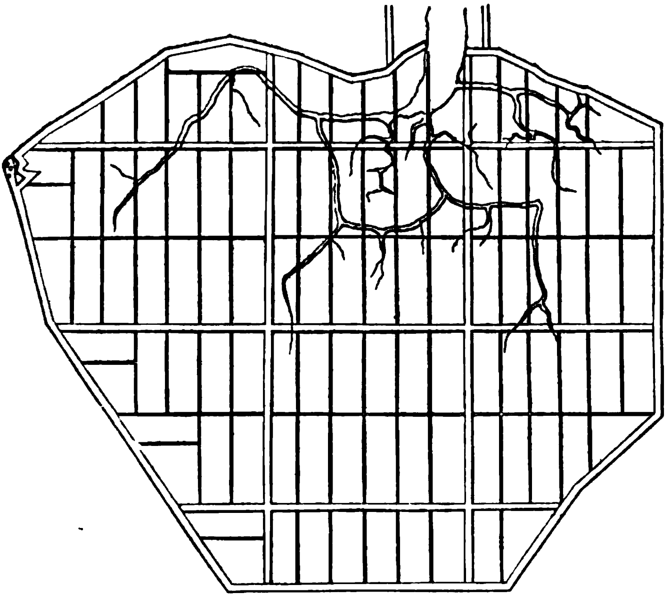
A great portion of these countries may be considered as alluvial; much of it formed from the recession of the sea and the elevation of the land; much by the gradual encroachments of the land upon the sea, as where, by the meeting of the tides with the streams of some of the great rivers, which here, by various channels, find their passage into the sea, a sand bank is formed, and presently, by successive deposits of mud brought down by the streams, an island or outstretching point is produced, which is gradually raised above the level of the tides; and, lastly, by the actual embankment by dykes of immense tracts, which still remain many feet below the level of the sea; and which form extensive basins or enclosures of almost unsurpassed fertility.

CXXX. THE DYKES AND POLDERS.

The extent and magnitude of these embankments is matter of inexpressible surprise; and one is compelled to ask, where and who are the men of such unconquerable and gigantic enterprise as to raise these extraordinary mounds; thus to defy the ocean; and thus to effect conquests, than which none more brave, illustrious, or beneficent, are recorded in history, and compared with which, military conquests seem to deserve only the execration of mankind.

The external dykes are from 125 to 150 feet in width at the bottom, with spacious roads on the top of them; and in several cases the water requires to be lifted twice before it is thrown into the sea. These immense tracts of land, which have been thus redeemed from the sea, are denominated polders. These polders are said to average more than eleven hundred acres each; and that 436 polders, embracing an extent of 475,000 acres, are kept dry by 815 mills. The water to be removed is of course the fresh water from rain, or the water from springs, and some, doubtless, from the infiltration of the sea. The work of one mill is required to keep six hundred acres sufficiently free from water. The whole amount of this poldered or redeemed land in Holland is represented to exceed five millions of acres, an amount to be redeemed from the sea scarcely within the limits of credibility. But the original erection of these dykes is not the whole amount of labour which they demand,—a demand which knows no interruption nor cessation. It is said, upon competent authority, that had the original dyke at Walcheren been made of solid copper, it would have cost less than it has cost in its formation and repairs.

I present here a sketch of the polder of Snaerskerke, given by Radcliffe from the government survey. This polder contains about 1300 acres, and was drained by order of Napoleon. "The creek, with its minor branches, by which the tide overspread nearly the entire surface, is traced, to point out its original state; but that has now given way to the regular divisions and arrangements marked by the parallel lines, which describe the present circumstances and appearance. The facility of this improvement is so obvious, that it is only surprising it should have remained so long unexecuted; the banks of more ancient polders, which nearly surrounded this, having rendered it unnecessary to do more than to shut out the sea at one point of influx, about 1450 feet in extent." Let us look next at the pecuniary result of this improvement. "The land which has been reclaimed by it was let for a sheep-pasture, at 25*l.* sterling, or about 125 dollars, and was thrown up by the farmer as untenable. Upon being dried by this summary improvement, the lots, of which there are one hundred, of thirteen acres each, were sold by auction at an average of 291*l.* 13*s.* 4*d.* each, or about 1458 dollars, and would now bring nearly double that sum[1]."



SKETCH OF THE POLDER OF SNAERSKERKE.

A great work of this same kind is now going on, which is no other than to drain the Harlaem Lake, and lay the bottom dry for cultivation. This great work has been some time in progress by means of powerful steam-engines, and when completed will lay dry about 50,000 acres[2]. The extent proposed to be drained is said to be seventy miles square. Another tract which has been laid bare contains 18,000 acres. It is impossible to contemplate these mighty and beneficent achievements but with the most profound admiration. But if an immense labour and expense have been devoted to their creation, a corresponding vigilance, a vigilance most laborious, indefatigable, and unceasing is required to maintain them. The inhabitants of this great country sleep always in the immediate neighbourhood of an enemy's camp, and are exposed to irruptions and invasions, against which all human power may be unavailing. The recollection of the floods, which have occasionally broken away these barriers, and swept the country, is perfectly terrific. In the course of thirteen centuries[1] no less than 190 great floods are said to have occurred in Holland; so that a destructive inundation may be said to have occurred as often as once in seven years, and the years so late as 1808 and 1825 were marked by great floods. In 1230, 100,000 persons are reported to have perished, with cattle innumerable. In 1410, 20,000 persons were drowned; and in 1570 an equal number. In 1717, the flood is reported to have destroyed 12,000 men, 6000 houses, and 80,000 cattle. The sea has been known, in some cases, to have risen eight feet above the dykes. These events are certainly among the most tremendous in history; and evince the extraordinary courage and perseverance of a people, who again repel the merciless invader, and bravely plant themselves directly upon the recovered field.

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[1] Radcliffe's Flanders.

[2] It is stated, that in order to exhaust the lake, 3000 millions of tons of water must be raised; and in order to keep it dry, 54,000,000 of tons must be raised annually; and sometimes 20,000,000 of this in one or two months. What a gigantic project!

CXXXI. THE WATER MACHINERY OR MILLS.

These countries have to exercise a double guard; the first against the irruption of the ocean, and the second against the overflowing of the great rivers, which, fed by streams from mountains covered with eternal snows, here divide into many branches on their way to the ocean; and likewise from the rain which falls, and has no way of escape but as it is pumped up and turned off into the rivers or the sea. In some cases, six, eight, and ten feet of water have been removed; it is stated "that in one case, a depth of more than thirteen feet required to be removed on land more than eight feet below the high water of the river into which it was necessary it should be discharged. It was raised into a reservoir, and let into the river at low water. The water required to be raised by successive lifts twenty-two feet, not an uncommon lift in Holland." The machines by which this water is raised are windmills, made with extraordinary care and expense, and presenting to the unaccustomed eye a peculiar but not unpleasing appearance. I counted more than two hundred in sight at one time, and was told that more than four hundred might be seen. These are variously constructed, some of them with a spiral screw working in a box to which the screw was exactly fitted, and by which large amounts of water were forced up without any heavy pressure upon the machinery. In other cases, the water was lifted with a simple paddle-wheel working in a common trough. It is stated that one mill will free 600 acres from water; but it is obvious that this must depend upon various circumstances, such as the quantity of water to be removed, and the kind of machinery employed. The most constant vigilance is required to take advantage of all the wind that blows. To give some idea of the expense of these operations, a mill is said to cost from 8000 to 14000 dollars, or from 1600*l.* to 2800*l.* sterling, and its operation costs 300 dollars or 60*l.* sterling a year. Many of the persons who have the care of these mills live in them with their families.

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[1] From 516 to 1825.

These are all windmills. Steam-engines would probably be as little expensive, and more under command. Most of these mills were erected before the use of steam in this way was known; but a reason given for preferring wind to steam is, that, as Holland has no coal, in the event of war she might be without fuel, and consequently unable to work steam-engines, the disastrous consequences of which it is not necessary to dwell upon.

Such are the mighty works, as well indeed they may be called so, which arrest the admiration of the visitor to this reclaimed and fertile region, so marked by the most extraordinary enterprise. They inspire a profound sentiment of the hardihood and enterprise, the courage and indefatigable perseverance of the people who undertook, achieved, and have maintained them.

CXXXII. FLEMISH AGRICULTURE.

The agriculture of Flanders is chiefly arable. To give a detailed account of its various crops and their culture, would be to compose a large work; and I shall therefore limit myself to noticing those peculiarities in their practice by which their cultivation is distinguished, with such remarks upon particular crops as seem interesting and useful. Flanders itself is to some extent a redeemed country; and they have also their polders and embankments, canals and dykes.

I begin by saying that the agriculture of Flanders is superior to that of any country which I have visited. I do not say that in England, Scotland, France, and Switzerland, I have not seen single farms as well cultivated as any I have seen in Flanders; certainly in the Lothians in Scotland, in Northumberland, in Norfolk, in Lincolnshire, in Bedfordshire, in Berkshire, in Cambridgeshire, in Staffordshire, and in other places, I could single out particular farms and considerable districts where the cultivation is carried to a high degree of perfection and productiveness; but taking into view the large portion of Flanders which I visited, for neatness, exactness, and thoroughness of cultivation, for the evenness and magnificence of the crops, for the propriety and exactness of the rotation, for the economy and excellent modes of applying their manures, and for the obvious and distinguished improvements made in the soils, this country seems unsurpassed. It is not a little humiliating that this has been done by a people comparatively without education, with no pretensions whatever to what is called agricultural science, and with few implements, and those far from being the most improved. To say, however, that they are without education and agricultural science, is a great misnomer. They have the surest of all science, that which grows out of long experience, and which comes from the application of the mind, sharpened by necessity, to whatever is passing within its own province, and avails itself of all the lessons which that experience suggests. I am far from thinking that with them the ultimatum of improvement has been reached. I should regret to find any where, in any science or art, the door of inquiry closed; but at present they may congratulate themselves with having reached a degree of improvement, which many other countries, with superior advantages in other respects, have not as yet approached. Though their implements have been imperfect, there is yet an obvious reason why they have been effectual. The great agricultural instrument in Flanders is a spade. We are contriving all kinds of implements which shall lessen human labour. We want all sorts of machines which shall, if possible, do the work of or by themselves. We want that they should be impelled by wind or by steam, or by brute force; and we would be glad, as far as possible, to dispense with the necessity of personal superintendence. The Flemish farmers reluct at no personal superintendence or toil; and even an inferior implement, with a thinking and directing mind at the end of it, may be more efficient than many a more complicated or better contrived machine, which is expected almost to make its own way.

CXXXIII. THE SOIL; AND SIZE OF FARMS.

The soils of Flanders are generally inferior; but they illustrate the Latin proverb, that persevering labour overcomes all difficulties. In many instances, the farmers plant themselves upon an almost hopeless blowing sand, which would seem to defy all vegetation. They will begin by planting oats, or rye, and broom; the oats or rye are used for forage, and so are the tops of the broom, which remains in the ground three years, and is then ploughed in to form and enrich the soil; and when by degrees they can advance so far as to grow turnips or clover, so as to feed a cow, the way of success is open. In such case, all manure, solid and liquid of every kind, is saved with care, and the whole redoubles itself; and after a time is witnessed the conversion of this arid sand into a productive soil.

The size of farms in Flanders is small, in many cases not exceeding fifty acres; often less than this, and not more than six or seven acres. The amount produced, upon even the smallest holdings is remarkable, and presents an advantageous, and often an instructive contrast with the product of large farms.

CXXXIV. THE CULTIVATION OF THE SOIL, TRENCHING, PLOUGHING, MANURING.

1. The first characteristic of Flemish husbandry is their deep cultivation. In some cases this is done by the spade, in others by the plough, and sometimes conjointly by the plough and spade. The land is gradually trenched to the depth of twenty

inches or more. The land for grain being laid out in stitches, six or seven feet wide, in the intervals a deep trench or ditch is dug, say of a foot in width. The next year, in cultivating this same land, a foot in width will be taken from the side of this stitch and thrown into the ditch or open space, widening, of course, the next bed to the extent to which it is cut off from the other; filling up the trench of the preceding year, and forming a new trench. This is repeated year after year, until, according to the width of the stitch or bed, the whole ground is gone over to the depth of a double spading. At the same time, as the successive crops have followed each other, the ground has been carefully improved by manure, until a fine rich and mellow bed of soil is formed. This operation resembles subsoiling, with this difference, that the work is more thoroughly and carefully done with a spade than it can ever be with a plough. A deep soil, where properly enriched, is obviously most favourable to vegetation. The air itself is a great enricher of the ground; water, another great element of fertility, passes through a well cultivated soil, leaving its fertilizing influences, without becoming stagnant, and so injuring the soil. All plants do not equally require deepness of soil, yet even the plants which appear most superficial often extend the fine tendrils of their roots in search of food much farther than the eye can follow, or than is generally supposed. A French farmer states that he has found the roots from a plant of wheat extending five feet. All taprooted plants, such as clover or carrots, frequent crops in Flanders, of course demand a deep culture.

The first object then of the Flemish farmer, is to get a deep and friable soil, well enriched, and, as far as possible, equally enriched throughout. This is done with great painstaking, and the whole resembles the most beautiful garden cultivation. Even where it is ploughed, the trenches at the sides of the field, and between the beds, are cleaned out by a spade; what is taken out is laid carefully upon the beds;

and the whole executed with a neatness and exactness the most particular, and perfectly delightful to the eye.

2. Subsoiling.—They have a peculiar mode of working their land in many cases, of which their best farmers think very highly, and which is well deserving of notice. Immediately after the plough has opened the furrow, workmen follow with a spade, and take out from the bottom of the furrow large spadefuls of earth, laying them up upon the turned land. Here they remain in lumps until they are reduced to fineness by the warmth and air, and spread themselves upon the soil. They have an opinion that this is equal to a good manuring. The next furrow slice of course falls into these holes, and to some extent there is a complete inversion of the surface-soil. This does not answer, however, where the land is clayey, or strong and adhesive, as, in that case, water would collect and remain in the holes made under the furrow with the spade. The object of the Flemish farmer is to have the ground thoroughly enriched and friable; and to give, as far as possible, a quick passage for the water which falls upon it, and free admission to the air.

3. Draining.—Nothing can surpass the pains-taking of the Flemish farmer in the preparation of his soil, as the basis of all his efforts, and that on which he rests his hopes of success. I have already said, that with a view to get rid of surface-water, he carefully lays his ground in stitches or beds, narrow or wide, in proportion to the quantity of water, which, from the situation of the land, may require to be disposed of. If the land is made wet by springs, he takes pains to cut off the springs by transverse ditches. These he fills with brush, or wooden boughs, and upon these he lays stones, and then covers with earth, and thus conveys the water into an open side ditch. This is a primitive mode of draining, and not the best which could be chosen; but after the wood has

decayed, the channel being once formed, it is likely to be kept open for a length of time, by the force of the running water. If the wetness of the land proceeds from its low and sunken position, or from springs which cannot be cut off, it becomes necessary then to cut it up by open ditches, which are made at distances varying according to the nature of the land to be drained, and into which the water becomes collected. This takes up a considerable portion of the surface, but the compensation is found by the dryness and availableness of the other portions, by which method only these could be secured. This is the universal practice upon the polders, and these principal ditches are often of sufficient width to proceed upon in boats, in order to take off the produce to the outer edge of the polder, where it can be removed in carts.

4. MIXING THE SOIL.—If the soil upon which he proposes to operate be composed, as often happens, of different strata of earth, as, for example, of mould, next of a layer of clay, and next of sand, he is careful, by a deep trenching, thoroughly to stir, and by degrees to intermix and enrich the whole. In truth, every effort is made to produce a deep, friable, rich bed for their operations; and by such means soils, which appear at first almost worthless, are made productive. Many soils, which in their original condition were sterile and comparatively worthless, now take rank with the most fertile.

5. ROTATION OF CROPS.—Another great feature of Flemish husbandry is that of a regular rotation of crops. This is exact, and observed with strictness.

What this rotation shall be, must depend on a variety of circumstances. An intelligent farmer will be likely to inquire first, to what crops is the soil best adapted, because of this he is likely to get the largest product; what crop is most required for his own use or for the market; what crop is likely least to exhaust the soil; what crop is he best able to manure. In short, a great variety of inquiries growing out of the nature and particular condition of the soil, which will determine the course of crops to be adopted by the farmer, having in view that which he can obtain with the largest profit, the least expense, and the smallest injury to the land. What are called green crops, with the exception of potatoes, which enter largely into human food, such as carrots and turnips, are grown mainly with a view to the manure, which they furnish by the animals fed upon them. The farm is divided into several portions, and on these different portions, distinct rotations are proceeding regularly, the aim of the farmer being to have a variety of crops growing at the same time. In this way he provides best for the supply of his family; having a variety of articles to dispose of, he runs less risk in the fluctuations and caprices of the markets; and he is enabled the better to husband and apply his manures.

I shall here give some examples of these rotations of crops, not as furnishing a rule for other places, which may differ very much in various circumstances, but simply as illustrating the practice of these careful husbandmen.

On a soil of a good quality, and on which wheat may be cultivated, the following rotation is sometimes observed:

1. Potatoes.
2. Wheat, with turnips sowed upon the stubble after the harvest.
3. Oats and clover.
4. Clover.
5. Rye, with turnips sowed upon the stubble after the harvest.
6. In grass, to remain as long as it is profitable.

The farm in a case like this, will be divided into as many portions as there are distinct crops, so that all will be growing on the same farm at the same time.

The following rotation is sometimes had:—

1. Wheat.
2. Rye and turnips.
3. Oats.
4. Flax.
5. Clover.
6. Rape.
7. Potatoes.

On a very strong soil the following rotation is given:—

1. Potatoes, 2. wheat, 3. beans, 4. rye, 5. wheat, 6. clover, 7. turnips, 8. flax, 9. wheat, 10. oats, 11. fallow, 12. tobacco, 13. rye, 14. oats.

The following rotation is adopted upon a stiff soil:—

1. Potatoes, with twenty tons of dung per acre.
2. Wheat, with three and a half tons, and fifty barrels of urine.
3. Flax, with twelve tons of dung, fifty barrels of urine, and five cwt. rape cake.
4. Clover, with twenty barrels of wood ashes.
5. Rye, with eight tons of dung, and fifty barrels of urine.
6. Oats, with fifty barrels of urine.
7. Buckwheat, without manure.

On a rich loam the following rotation is pursued:—

1. Turnips, carrots, chicory.
2. Oats and clover seed.
3. Clover.
4. Wheat.
5. Flax.
6. Wheat.
7. Beans.
8. Wheat.
9. Potatoes.
10. Wheat.
11. Oats.

Wheat occurs in this rotation four times in eleven years. Clover, which occurs twice, is to be considered as the only enriching crop. Manure is applied, however, the first, third, fourth, seventh, and ninth years. The cultivation is most careful, and no weeds are spared.

I have given these different rotations from Van Aelbroeck's account of Flemish husbandry.

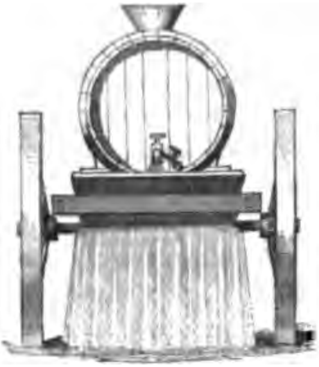
It may not be easy to point out in every instance the principles on which these rotations are founded. With the Flemish farmers they are the result of long experience and observation. Perhaps they might often be changed to advantage. I have known, for example, in some parts of the United States, flax cultivated to great advantage every fourth year; and in some parts of England wheat grown every second year. But in each case the land was highly manured, and in the former case the land was comparatively a new and unexhausted soil. My object in going into this subject was not to prescribe a particular course, but to illustrate a great principle of Flemish husbandry, which will be found equally applicable to every situation. The necessity of a rotation of crops seems fully established. The kind of rotation to be followed must be determined by the peculiar circumstances of each locality, remembering only, that two crops of a similar character must not immediately succeed each other; that the occasional intervention of a cleansing crop—that is, a crop which requires thorough weeding—is indispensable; and that those crops which are to be consumed on the farm serve a double purpose, in addition to the animals which they sustain, they supply the manure which is demanded. The necessity of naked fallows—that is, of leaving the land wholly unoccupied with any crop, that it might recruit itself, and the weeds be exterminated by repeated ploughings—is no longer acknowledged; and cleansing crops, which are manured, may be substituted, greatly to the farmer's advantage.

6. MANURING.—The next great feature in the Flemish husbandry lies in their system of manuring. In the first place, they manure their land abundantly. In one of the rotations to which I have referred (p. 525), the first six crops were each of them liberally manured. The seventh, which completed the course, which was buckwheat, was without manure. In the next rotation (p. 525), where the rotation extended to eleven crops, five of them were manured. That the manuring was of a liberal character, is seen in the appli-

cation of sometimes twenty tons of manure to the acre, and sometimes twelve tons, with the addition of fifty barrels of urine. Indeed, the first object of a Flemish farmer is to increase his stock of manure; to this end he suffers nothing which can be converted into manure to be lost or wasted; and besides that which he makes from his savings and his domestic animals, he is always ready to purchase manure, where it can be found accessible, the various canals in the country furnishing great facilities for its conveyance. Perhaps there is only one point in which he is often deficient, and that is, in not raising sufficient green food for the support of cattle, with a view to increasing his manure.

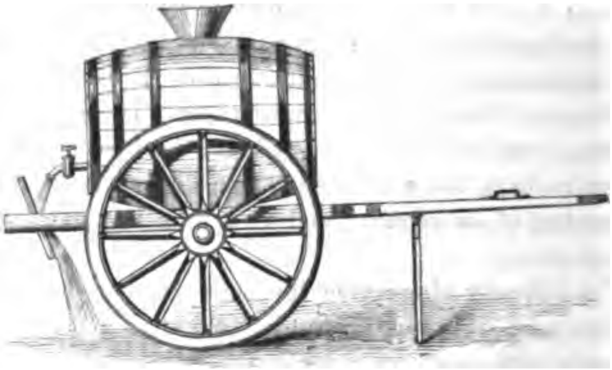
7. Liquid Manure.—It is not merely in manuring liberally that Flemish husbandry is remarkable, but in the particular mode of applying this manure. The great object of the Flemish farmer is to apply it in a condition to be immediately taken up by the plants. Coarse and long manure he ploughs under in the autumn, that it may be in a condition to serve the crop which is to be sown in the spring. Or, if to be applied in the spring, he so works it over and prepares it, that it is in a condition at once to serve the plant. But the distinguishing circumstance in Flemish husbandry is in the application of liquid manure, both to the land before the sowing, and likewise to the growing crop. In such case the growing crop immediately receives it; receives it at a time when, perhaps, the manure first applied has begun to lose somewhat of its efficacy; and in a form that its efficacy is felt at once.

The difficulty of applying this liquid manure to the crops on the land is often considered an objection to its use; and there is, with many persons, a fastidiousness in regard to the use of it, which is quite absurd, and leads to the sacrifice of the most valuable and efficacious manure which is at the command of the husbandman. In some cases it is turned into the small ditches or furrows between the beds or stitches, and then with a spade thrown on to the beds with some of the soil by which it has been absorbed. In this case a light plough is sometimes passed through these intervals or small ditches, between the beds, so as to loosen the earth by which the liquid has been absorbed. But most commonly it is applied directly, by means of a cask constructed for that purpose, resembling the vehicles used for watering the streets of cities.

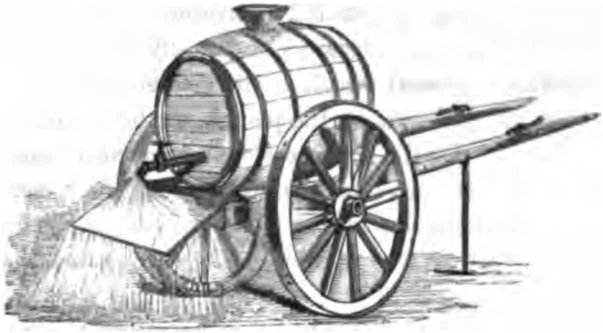


In the subjoined diagram the liquid from the cask falls into a trough placed horizontally, and pierced with holes, by which means it is very equally distributed.

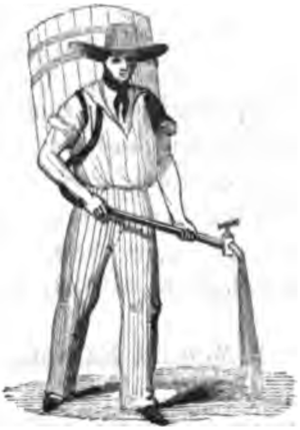
In other cases, where the liquid is too thick to be distributed through these holes, it is, in passing out, made to strike against a plank or board, by which means it is scattered evenly upon the ground. Thus:—



In my opinion, if the liquid was made to fall upon a plank which should be placed behind, at a slight inclination, it would be more effectually spread. Thus:—



In case of small farms to which this manure is to be applied, and where the cultivator has only his own labour of which to avail himself, he adopts a method of distributing this manure, of which the subjoined cut will give an idea; but which, I can easily suppose, may not be agreeable to persons not accustomed to it. The Flemings, however, reluct at no labour by which their objects may be obtained.



In some cases it is transported into the field by means of a wheelbarrow, with the cask containing the liquid suspended between the shafts. There are acknowledged inconveniences attending its application; but many of them are purely ideal, and the extraordinary value of the manure, when thus applied, is an ample compensation for any extraordinary labour or expense, which its saving or its distribution may cost.

8. Cleanness of Cultivation.—Another feature in the Flemish husbandry is the cleanness of their cultivation. They spare no pains in the eradication of every weed. They have, in this matter, much to contend with. An old

country under a highly manured cultivation is liable always to be much infested with weeds, and especially with the squitch grass (*triticum repens*), which is their chief trouble. What cannot be accomplished by the plough, or the harrow, or the hoe, is done by hand; and occasional recourse is had to a naked fallow. In such case a fallow crop, that is, a cleansing crop,—a crop, the cultivation of which would effectually destroy the weeds, would be more eligible. The old doctrine, that the land absolutely required rest, with a view to the recruiting of its powers, is now exploded. With ample manuring, and a rotation or change of crops, its occupation may be unremitted.

CXXXV. MANURES.

I proceed to the subject of manures, as it presents itself in Continental husbandry. The Flemish call manure "the god of agriculture." Of its importance not a word need be said; and the Flemish, in the pains they take in its accumulation and use, evince the estimation in which they hold it. Manure is indeed the foundation of all good husbandry.

1. **Mineral Manures.**—Manures divide themselves popularly into three kinds, mineral, vegetable, and animal. Of mineral manures, such as lime, gypsum, and marl, the use seems well understood, but, within my observation, they are not applied to so great a proportional extent as in England and Scotland. Lime, or the carbonate of lime, is employed upon lands which are clayey, cold, and heavy; and in such case it answers a double purpose, to divide the soil and render it light and friable; and secondly, to warm the soil. That plants take up some portion of lime from the soil is established; but this is so small an element in their composition, that few soils are found deficient in the necessary quantity. That it should be applied to the land in a caustic or warm state seems like-

wise an established point. Some of the Flemish farmers advise to the mixture of lime with earth, and to its application in that form; but this seems only an increase of labour without any obvious advantage. Others advise to the mixture of lime with heaps of vegetable matter, so as to reduce it; but, in such case, it is likely to destroy some of the most valuable parts of the manure. The efficacy of a dressing of lime is considered by the Flemings to endure three years; but this must obviously depend upon the quantity applied. Thirty bushels of unslacked lime after being slacked is considered by some farmers a proper application; while others advise the application of thirty bushels each year for three years in succession.

I have met with the frequent application of marl to light lands, and to the surface of peat-lands, where it soon forms a productive soil. The application of gypsum can scarcely be said to be general. It is sometimes applied in the ground to the seed of potatoes in the planting, in which case it is generally admitted to improve the quality of the potato; and it is applied also by being sown broad-cast upon young clover; in this latter case, ordinarily with success. The philosophy of its operation is still obscure. It is difficult to say why it fails; but it is not less difficult to say why it succeeds. It will sometimes be useful, and at other times without effect, in the same locality. This I have myself experienced. A very competent farmer in the United States gives it as his opinion, and the result of his experience, that it sometimes failed of its effects from being too coarsely ground, but that it always succeeded when reduced to an impalpable powder.

Much has been said of the value and efficacy of sea salt as a manure, and in France great complaints have been made of the heavy duty, which in fact prevented its use in this way. A distinguished French farmer and experimenter, who has devoted much time and expense to this subject, and has furnished most exact accounts of his experiments and observations, has come fully to the conclusion that it is of no use whatever as a manure, and equally useless in the fatting of animals. These conclusions are different from the popular notions, which seem always entitled to some respect; but they are fully borne out by the experiments, repeated and varied, of this indefatigable inquirer.

2. Vegetable Manures. — Of vegetable manures I have only to say, that buckwheat and clover are often turned in by the plough, and with acknowledged advantage. The Flemish make a point of collecting every species of vegetable refuse which they can find, all vegetable matter growing upon the sides of the roads and that which is found in the canals. They are careful likewise to plough in their stubbles, excepting where there is another crop on the ground, such as clover or carrots, which are sometimes sown among the grain soon after the crop is harvested.

Under this head may likewise be placed ashes, of which the Flemish make great use. A large part of the fuel consumed in Holland is peat or turf, and the Dutch ashes are highly valued as dressing for clover. These ashes are imported from Holland into Flanders in large quantities in boats, and always find purchasers. They are applied as a top dressing to dry meadows, as well as to clover and likewise to flax. It is not well determined on what their particular efficacy depends.

The ashes of sea-coal or mineral coal are likewise used as a manure, but they are deemed very inferior to the Dutch ashes properly so called. Heath lands are sometimes lightly skimmed, and the heath burnt for the sake of the ashes; but if it is intended to cultivate the land or to plant it for trees, it is deemed hurtful to remove the ashes of the surface. Wood ashes and the ashes from the soap boilers are likewise most carefully saved and applied. Wood ashes are not easily obtained, because of their extensive use in the arts. The ashes from the soap boilers are much esteemed by the Flemish for strong and moist lands, and have a value from their containing a considerable quantity of lime. The refuse from the bleacheries, which contains a large quantity of soap, is more valued for dry and light lands; both of these manures are greatly esteemed for clover and for dry meadows. Their effects are understood to last for three years, and they are more efficacious the second than the first year.

The cakes from the colza or rape, which remain after the oil has been expressed, are very much used for manure; in which case they are thrown into the urine cistern, and applied thus mixed. They are supposed very much to increase the efficacy of this liquid manure. Within a few years however, as I learnt at Courtray, these cakes have been used with advantage for the feeding of cows and swine.

In some parts of France and Belgium the stalks of the colza are ploughed in for manure, and sometimes burnt upon the ground, reliance being placed upon the efficacy of the ashes; and in some of the wine countries, the cuttings of the vines are dug in for manure, it is said, with singular efficacy. It is thus that that which has been taken from the earth for the growth of a plant, is returned to it as a principal element in the growth of the same kind of plant which is to follow.

Soot is likewise used as a top dressing with great advantage, and is considered twice as valuable as ashes. It is applied to the young clover and to garden vegetables; and is estimated highly for its power in destroying insects. Under good management, every article capable of being converted into vegetable food, or of enriching the earth, should be saved as manure.

I have already spoken of the use of the drainings of the factory where potatoes were converted into starch: their effects upon grass-land were most remarkable. I have in another place spoken likewise of the use of the water in which flax has been rotted. I have seen the most beneficial results from it; but I am not aware of its use in Flanders.

This water is conveyed from the starch factory into a basin or excavation, where, after remaining a short time, it makes a considerable deposit. This deposit is taken out and spread upon the land, or thrown into and mixed in compost; and the water is drained off, and conveyed upon the field by small ditches or rills.

3. Animal Manures.—The great reliance for manure, however, every where is upon animal manure, the excrements of animals, and animal substances. One of the most obvious deficiencies in French husbandry is a deficiency in manure. They are not accustomed to folding sheep upon their lands, as is common in British husbandry. They grow very little of esculent vegetable food for their live stock, such as turnips and carrots; and their cattle are kept in the winter often very hardly upon straw. In summer their cattle are much in the pastures, overlooked by a herdsman or a child, so that the manure is scattered.

There is likewise a manufacture of manure called *animaliée noir*, which consists in boiling down the flesh of animals, such as horses for example, or animals which have died of disease and are unfit for food; and after it is boiled, baking it in an oven, when it is brought into a state easily to be reduced to powder. There is a manufacture of this same kind of manure in London; but, strange to say, the product is exported to France. The refuse of the sugar refineries, that is, the animal charcoal, or ashes of burnt bones used in cleansing the sugar, is highly esteemed as a manure; but it is advised by the Flemish farmers to mix it with their liquid manures in the urine vault. This manure is much employed in France. Its chief value is on heath and moist lands. It does no good on rich, highly cultivated land. It is spread broadcast for grass, and its effects are surprising. It is applied to wheat land at the time of the sowing of the seed: it is deemed much preferable to apply it in the autumn rather than in the spring. It is applied in France at the rate of four hectolitres to an acre, which would be at the rate of more than eleven bushels.

The Swiss, likewise, are remarkable for their care of their manures. The heap is usually placed in front of the house, a slight excavation being made for it so as to form a basin into which the liquids are drained. The long manure is laid at the sides, and doubled in with the greatest care, and no little skill, so as to form a neat and compact pile in a square or oblong form. This seemed to be almost a universal practice; and the neatness and exactness with which it is laid up are quite remarkable. The manure from the stables and the refuse of the house is deposited daily upon it; and the drainings which run down to one end of the basin in which the manure heap is placed, are often pumped or dipped up, and returned upon the pile. The odour of the heap directly by the door and under the windows of the house cannot be agreeable; but the extreme neatness with which it is formed, and the cleanliness and care which mark ordinarily every thing about the premises, do much to redeem its offensiveness.

In their economy of manures, in their modes of applying them, in their extraordinary liberality in the use of them, the palm must be conceded to the Flemish over all other people. The best Flemish farmers advise against the general mixing of manures. Their doctrine is, that as different animals demand different species of food, as well on account of their habits or constitution as on account of their taste, so different plants and different soils require specific and peculiar manures. I shall not discuss the question how far manure is to be considered as the food of plants. It is enough for us to know that manures are indispensable to their growth, and that different manures are very different in their various properties and effects. The manure of the horse is a powerful and warm manure, and considered as best suited to lands which are cold and moist. It operates quickly; it lightens the soil; but its effects pass off sooner than those of many other manures. The manure of horned animals is deemed more substantial, slower in its operation, and more durable in its effects. The Flemish farmers say, that where a second crop is raised upon the ground, the effects of this manure are more apparent in the second than in the preceding crop. It is obvious, however, that the quality of the manure must depend very much on the kind of food upon which the animals are fed. The simplest experiment made with the original and most common of all chemical instruments, the human nose, will at once determine the superior efficacy of the manure of animals highly fed with esculent vegetables and grain or meal over that of animals fed upon straw only. The manure of swine is considered by the Flemish as of very little comparative value, and where used, in order to produce as much effect, they advise to employ full double the quantity which they would use of cow manure. My own experience has led me to rely upon the dung of swine as among the strongest of manures; and the low estimate which the Flemish farmers place upon it must come from the hogs among them being fed mainly upon grass; and from what I have seen, both in Belgium and France, being very poorly kept at the best. The swill pail, which is found at the kitchen door in the United States full of butter-milk and whey intermixed with cooked vegetables, broken pieces of meat and bread, is, alas! not to be found at many cottage or farm-house doors on the European Continent. The whey and the butter-milk are wanted for the table; and it would be a species of sacrilege to give meat, which a large portion of the labouring people seldom or never taste, or bread to the swine. The dung of swine is, however, in the best cases, to be considered as a cold manure, and not easily brought into a state of active fermentation.

The dung of sheep is every where highly esteemed. It is active and powerful; and upon light and moist lands they rate two loads of the dung of sheep as fully equal to three of the manure of other brute animals. It is much used with the oat crop; but it is not advised for flax, as being apt to force it to a premature ripeness. Valuable, however, as is the manure of sheep, I have seen on the Continent no instance of the excellent practice of folding sheep, which prevails so generally in England and Scotland. In the bergerie, or sheep-house, where their sheep are brought at night, they are careful to spread an abundance of litter, which is generally removed twice a year, in the spring and autumn. They begin with a simple layer, which the feet of the sheep soon reduce to fineness, and so proceed layer by layer to a depth of three or four feet, which thus becomes throughout its whole thickness thoroughly impregnated with urine.

In some cases where the farmer does not find it convenient to purchase or own a flock of sheep, he receives one to keep or board for another person. In this case he furnishes straw for their litter in the stables on his own account; and he furnishes what hay, or grain, or pulse, they may consume at the expense of their owner, at the current prices, or such prices as may be agreed upon; and he boards and lodges the shepherd with his two dogs, who has the care of the flock, at about fifty-four dollars, or eleven pounds sterling, a year. He does this for the sake of disposing of his produce and of the manure. In the Lothians, Scotland, I found several instances in which the crops of turnips, or ruta-baga, were disposed of in the field to persons bringing sheep from the interior, to be consumed where they grew. Where practicable, this arrangement is excellent. The Flemish are of opinion that a hundred sheep, well fed, will give in a well-littered stable or bergerie from fifty to sixty loads of manure of more value than eighty or ninety loads of any other stable or barn manure.

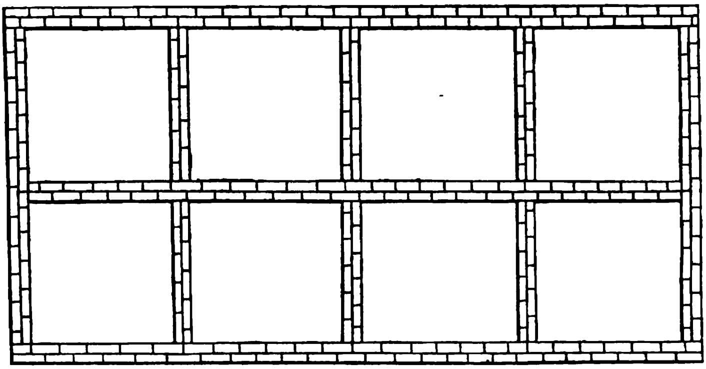
I have already spoken of the supply of manure obtained by the Flemish from the numerous distilleries which existed in Belgium, by the immense number of animals which were fed and fatted on the refuse grains of those distilleries. But these supplies are almost entirely cut off.

Another species of manure, much valued on the Continent, and especially among those careful husbandmen, the Flemish, is that of pigeons and barn-door fowls. The superior efficacy of these excrements over most other manures is acknowledged. The excrements of birds are voided only in one form, and may therefore be supposed to possess the greater strength. This manure is saved in Flanders with the greatest care. Contracts are often made with persons who keep pigeons for their manure. A hundred francs, or twenty dollars, is sometimes paid for the manure of six hundred pigeons. The manure goes under the name of columbine. The saving of this species of manure requires particular care. It is advised to spread the floors of pigeon-houses and poultry-houses with fine sand, that this manure may be thoroughly intermixed with it, and a fermentation be prevented. If no care is taken of it, it is wasted, or it becomes full of maggots and vermin, which infest the birds. Sometimes it is applied mixed with water, but oftener in the form of powder. The dung of pigeons is considered more powerful than that of barn-door fowls; but the reason is not ascertained. The dung of geese is not so much valued as either, perhaps for the reason that they feed on grass. The birds, whose excrements form the guano, feed wholly upon fish.

Guano has been used to some extent in France, but its use is much discouraged by the extraordinary adulterations which have taken place in it. These adulterations, according to chemical analysis, have amounted to ninety per cent. Where it has been used, its fertilizing powers have been acknowledged; but the French farmers whom I have met with have not considered it superior in efficacy to poudrette, or dried night-soil. On a visit to a French farmer, about twenty miles from Paris, the state of whose farm would have been creditable in any country, and was certainly inferior to that of few farms which I have visited; he informed me that he had made trial of stable manure, of guano, and of poudrette; and that he found the guano powerful, that the stable manure produced the largest growth, and that the poudrette produced the best grain. It is obvious that we want many more details and circumstances to form any strong conclusion from this experiment. In all cases, however, among the French, which came under my notice, I found a strong approval of guano, but the preference given to poudrette. More experience may result in a different verdict.

4. LIQUID MANURES, AND MEANS OF SAVING THEM.—The preparations for saving the liquid manure, which are universal in Flanders, and which are occasionally met with both in France and Switzerland, deserve the most particular mention. There is good reason to believe, that, if it could be saved and applied with equal ease, the liquid manure of an animal is of more value than the solid excrements. The Flemish farmers suffer nothing of this sort to be lost; and it is stated that in Ghent the servants receive a compensation for saving the waste waters of the house.

On a Flemish farm there is always a urine cistern, usually adjoining the stable or cow-house. A gutter or trough behind the cattle or the horses conveys all the liquids into this cistern, which is placed outside, rather than immediately under the cattle, that it may be accessible both for the removal and the mixture of other matters. This cistern is sometimes twenty feet in length, twelve in breadth, and six in depth. It is built of bricks, and the bottom laid in cement, so as to be water-tight. It is sometimes divided into two great compartments, and sometimes into several, as in the subjoined diagram.



These different compartments are designed to preserve the liquid of different ages separately. Each compartment is accurately gauged, and there is a fixed scale in each compartment, or in the cistern, where it is not separated, by which, from the height of the liquid, the quantity is easily determined. This is necessary for two purposes; first, in case of the sale of the manure, and second, in its application to the soil; in both which instances it may be important to know the quantity. In addition to the saving of the urine, the stables are frequently washed with water, and this likewise runs into the common receptacle. It is deemed best not to apply the urine until it has some age, and has passed through a degree of fermentation.

In order to increase their stock of manure, the farmers purchase large quantities of manure, such as the emptyings of privies in the cities; and these are carried in boats prepared for the purpose, on the different canals, to the farms which are accessible; and many of these farms have places of deposit, or cisterns for the reception of this manure, directly upon the borders of a canal, that there may be little trouble in discharging the load. This is a double good to the cities and the country: to the former, in getting rid of their impurities, and preventing the diseases which they might engender; to the latter, in enriching their lands. In many cases these places are used as deposits for the use of manure merchants or dealers, who collect large amounts, and dispose of it in such quantities as may be needed to the neighbouring farmers; who buy according to their means or necessities. It is sold by the barrel or tun, and is measured by the scale in the tank, or the vessel in which it is removed. Sometimes the cisterns are covered in with brick, arched, and emptied by means of a pump; in other cases they are emptied by means of dippers and buckets; and it is important that they should be accessible, so that the sediment may be removed as it may collect. Sometimes the cistern is a mere round well sunk in the ground, and emptied by a pump. But the form is of little importance, provided it be secure and convenient, compared with the matter of saving all this refuse, the importance of which I have already most urgently insisted upon. To the great credit as well as to the great gain of the Flemish farmers, nothing of this kind is ever wasted; and the cleanliness of the Dutch towns and cities is certainly not surpassed, and scarcely equalled by any others.

A good deal of stress is laid upon having the cistern outside of, and detached from the stable, that the fumes from it may not injure the air of the stable, to the prejudice of the health of the cattle, or those who tend them; and likewise on having different compartments in the cistern, that the liquid may have obtained a certain age before it is applied. They are in the habit, likewise, of mixing rape cakes, or the cakes which remain after the oil has been expressed from the rape-seed, with the urine, which in this way forms a most efficacious manure. These cakes weigh generally about half a pound, and are sold by the hundred or thousand. The amount of this manure applied to the land is often very large; liberal and ample manuring being one of the great principles of Flemish farming.

5. Compost Heaps.—The Flemish have, likewise, a mode of preparing a compost heap, which is greatly approved among them. They collect the scrapings of ditches, the vegetable matter which is floating in them, heath, bushes, stalks of vegetables, and any waste vegetable matter which they can gather; with this they mix a certain quantity of earth or soil, and then add quick-lime in about the proportion to the heap of one-tenth or one-fifteenth. This heap is several times shovelled and cut up with a spade, until it is in a state of sufficient fineness to be applied to the field. In the Pays de Waes, a district of country between Ghent and Antwerp, the cultivation of which is not surpassed in any part of the country, perhaps not in the world,—for I can hardly think of any culture more exact, more clean, or more beautiful, or any crops more luxuriant than I saw here,—the practice of the farmers is to place this heap near the side of the field intended to be cultivated, and then to pour upon it a copious sprinkling from the cisterns; the heap is then shovelled over, and the whole thoroughly intermixed; in which case it becomes an excellent manure to be applied before sowing.

6. Jauffret's Manure.—The preparation of Jauffret, which has had much celebrity in France, deserves notice here. I have seen one similar applied, and with success, as far as the object aimed at was concerned, in the United States. The object of this invention was to find some means by which straw, brush, ferns, heaths, broom, and other woody substances, might be speedily brought into a state of decomposition, so that the mixture might be applied to the land. He supposes it possible to supply nutriment to the land in this way, without the aid of animals. He advises, therefore, to collect a heap of materials composed of vegetable matter, such as straw, ferns, heath, broom, turf, bushes, small branches of trees, stalks, &c.; and when this heap is made, the articles being intermixed and pressed together, you are

then to prepare near it a liquid of the following materials:—

100 parts of fæcal matter and urine.
25 „ soot from the chimney.
200 „ gypsum in powder.
30 „ unslacked lime.
10 „ unleeched wood ashes.
A small quantity of salt.
„ refined saltpetre.
25 parts of the drainage of a manure, heap, or of liquid fæcal matter.

These matters are to be mixed in a place near the heap, with water enough to make a quantity of liquor sufficient to water this heap, and, in a few days, produce such a state of heat and fermentation as will reduce and wholly decompose it. The plaster or gypsum must be applied by slow degrees and in small quantities; otherwise, it would become hard. Near the heap, which should be placed on a piece of ground slightly inclined, should be a basin or hole to receive the drainings of the heap, that they may be returned upon it. The washings or applications of the liquid must be repeated, and holes occasionally made in the heap to receive it. In a favourable temperature, it is stated that a fermentation will commence in forty-eight hours, and that in twelve or fifteen days the whole matter will be so reduced as to be in a condition to apply to the land to be ploughed in with advantage.

I am not able to give with great accuracy the various proportions of ingredients which are prescribed; but this general statement will be sufficient for practical purposes, understanding only that there must be a sufficient quantity of the liquid thoroughly to impregnate or saturate the heap. Several other mixtures have been prescribed by different individuals, which produce the same effect; the only question is that of cost. I do not deem it necessary further to refer to them, as they have been given in various forms to the public. Any cheap process, indeed, by which such crude materials can be decomposed must be valuable, especially when the articles themselves, of which the application is composed, are of an active and enriching nature. In general such prescriptions are looked upon as a species of quackery; but Jauffret's method has been much approved in France.

7. GENERAL REMARKS ON MANURES.—I have heard from some farmers who claimed to be highly practical and intelligent, great distrust expressed of the value of liquid manure. They have applied to their lands, with comparatively small effect, the drainings of their dung-heap; but, as a capital Swiss farmer observed to me, the drainage of a manure heap and the contents of a urine cistern are very different matters. The former is, of course, in strength and efficacy very inferior to the latter.

The Flemish farmers, in the application of their manures, aim at two objects: the one to have their manure in a form, in which it can be immediately taken up by the plant; the other to apply it at a time when it is directly needed. In a liquid form it is, of course, most accessible to the demands of the plant, and they apply it at the time of sowing; and to some crops repeatedly afterwards, when they are in a growing state, and the effects of the first application are exhausted. They are, likewise, most liberal and indefatigable in the application of their solid manures, not limiting them to the surface, but mixing them with the whole soil by thorough and deep trenching.

CXXXVI. CROPS.

I have already treated fully of many of the crops cultivated on the Continent, but there remain some few others in the culture of which the Flemish distinguish themselves, to which I shall refer.

1. Colza is a plant cultivated largely in parts of France, but very extensively in Flanders, where it may be considered as a standard crop, the culture of which is carried to great perfection. It is a species of the cabbage family, and is cultivated for the oil which is expressed from the seed. It occupies the ground nearly a year, being sown in July or August, or transplanted in September or October, and gathered the ensuing July. The product of a good crop in seed is estimated at thirty bushels. It is considered a great exhauster of the soil, but it returns in its refuse much of what it receives. The stalks are often converted into manure, and are frequently used as fuel in cooking food for cattle, and in heating ovens. The land on which it flourishes best is a strong rich soil rather inclined to sand, yet argillaceous, moderately humid, and with a deep fertile bed. It must be well drained, so as to allow of no standing water upon it, and it must be well manured. The best preparation is a green sward, or a clover ley broken up; it often, however, follows rye or barley. It is important that the cultivation should be thoroughly clean. When sown on stubble, the stubble is first to be thoroughly harrowed or ploughed to the depth of two or three inches, and then, the weeds being cleared from the land and the manure spread upon it, the whole is to be turned over by the plough to a good depth.

The seed may be sown broadcast, or it may be sown in drills: in the latter case it is more easily kept clean; or the plants may be grown in a nursery, and transplanted. In case of transplanting, the crop is usually much better, and the oil made from it of a superior quality; but the labour and expense are considerably increased. When sown broadcast it is sown very thin, and cleared out so as to leave the plants about one foot apart. When sown in drills, the drills are more than a foot apart. When transplanted, the plants should first be grown in an ample seed bed, and set out at the distance of a foot from each other in double rows, the intervals between the double rows being eighteen inches. The land is ordinarily laid in stitches on which four or six rows may be planted; the land in the intervals dug out with a spade, and laid on the bed in the autumn, and in the spring this dirt levelled, the soil gathered up round the plants, and the whole kept thoroughly clean.

In December, when the ground is frozen, it is sometimes watered with liquid manure from the urine cistern in which the rape cakes have been dissolved; and this manuring is sometimes repeated in the spring to the great advantage of the crop. This liquid manure is sometimes applied most beneficially immediately before sowing the crop. Wood ashes are likewise recommended as a manure; and some farmers in Germany, when the plant presents four or six leaves, give it a dressing of plaster or gypsum. Marl on light soils is likewise extremely beneficial; this is carried on to the land in a season favourable to this work, and then spread and distributed by a harrow.

The seed is often sown broadcast; but it is very prejudicial to the crop to sow it too thickly. There are three different modes of transplanting the crop; first, by a spade, when the workman makes the hole by plunging the spade into the ground to its full depth, when, pressing it from himself, children, who work with him, place two plants in the hole; then with drawing the spade the earth falls back upon the plants, and a pressure of the foot between them finishes the operation. Or a dibble or planter may be used, which makes two holes, into which the plants are placed, and the earth closed up by hand; or a furrow may be struck with a plough, and the plants laid along in the furrow on the side of the furrow slice, and a second passing of the plough will throw the dirt directly on the roots of these plants, there being a workman to follow the plough to relieve plants, which have been too much covered, or to cover those which have received too little dirt upon them, and to set up those which have fallen down.

The plants, which are grown in a nursery bed, should have plenty of room; and soot is recommended as an excellent manure for them, as well as for the field after they have been transplanted. The plants, which are designed to be set out, are sometimes kept out of ground five or six days. The design of this is to check vegetation, so that they may not advance too rapidly before the winter, lest the severe frosts should injure them. It is not considered indispensable to manure the field upon which the crop is to be planted, if it is in a good state, or if the previous crop has been manured, though the crop will bear the usual relation to the richness of the land.

The crop follows rye or wheat with advantage, or clover; but in the case of rye or wheat, the stubble is to be thoroughly cleaned. The crop is to be hoed during its growth, and earth drawn round the plants. The plant has dangerous enemies in flies and bugs which attack it. Against the flies a dusting of quick-lime is sometimes of use; but the bugs are with difficulty dislodged, unless by a frost. The frosts, however, when they occur nightly with warm days, are injurious to the plant; much less, however, when the frosts are followed by fogs. It is the habit of small farmers to pluck a portion of the leaves as food for their stock; but this is attended by a diminution of the product.

The harvesting of the crop is a business requiring much care. It must be gathered before it is completely ripe. In good weather it can be laid in small heaps and dried, and then shelled out on cloths upon the field; or it may be stored in a barn after it has become sufficiently dry. In wet weather it may be heaped up with layers of straw between the layers of colza, until a return of good weather. If suffered to become too dry, it is liable to lose much by shelling out. In cutting with a sickle, the workman is cautioned against taking too many stalks in his hand at one time, as more likely by so doing to shake out the seed.

I have already spoken of the value of the cakes as manure, though they have been much used of late for feeding stock, which they informed me at Courtray was a modern practice. The clean cultivation of colza, and the ample manuring, serve eminently to prepare the land for wheat.

2. Navette.—A smaller kind of colza, called navette, is cultivated where the land is too light for the larger kinds. It is cultivated for the same purpose, though the produce is seldom more than two-thirds that of the other. Its produce is considered more valuable, and sells for a higher price. It is sown broadcast; and requires the land to be well cultivated and manured. The navette, a rape of summer, is sown in the spring, and ripens its seed in September. This kind is much sown in parts of England, as feed for sheep; but is seldom suffered to go to seed. It produces a healthy feed for sheep, and in good land a most productive vegetation. It sometimes, as I have observed in another place, affects badly the ears of sheep. The navette, a rape that is sown in autumn, has the advantage of bearing the frost well; and is much benefited by being harrowed in the spring

3. Poppy.—The poppy is largely cultivated in Flanders; but I have no recollection of seeing it any where else, though it often appears as a weed in fields of grain, both wheat and oats. It is cultivated for its oil, which, when properly managed, is much esteemed. It is grown in small quantities in gardens for medical purposes as a narcotic; in which case the heads with a piece of the stalk are cut off before their maturity, and hung up to dry, and the opium extracted by the druggists.

The poppy cultivated is of two kinds, the white and purple. The latter kind produces the larger quantity of oil; the former the best quality. There is another difference; the head of one kind being much more open than that of the other; and the former kind is almost exclusively cultivated in Flanders. The soil required for the poppy should be strong and mellow, and, as far as may be, protected from cold. It should be well cleaned from weeds. Though ordinarily sown broadcast, it would be preferable to sow the seed in drills, that it may be easily hoed. The plants should be left about a foot apart. It succeeds well to grain, and especially to hemp; in which case the manuring is not required to be repeated. It is especially recommended to follow potatoes, where the ground has been well cultivated and kept clean. When it is intended that the poppy should succeed potatoes, the potatoes should be well manured. When it follows any of the grains, several loads of manure should be given to the land for the crop. This manure may be applied in the autumn or spring; but in either case it must be ploughed or harrowed, and thoroughly mixed with the soil. There is danger of sowing the seed too thickly, and therefore it is advised to mix the seed before sowing with one portion of earth and two portions of sawdust. As soon as the plants appear, they are to be weeded and cleaned with great care; and when a foot in height, to be hoed and slightly earthed up.

The gathering of the seed of the poppy is to be done by hand, and at different times. As soon as the heads have acquired a degree of ripeness, they are to be carefully shaken over a basket or bag, so as to save the first loose seeds. This is afterwards to be repeated before the general harvest, when the whole is to be gathered by cutting off the heads. The shelling of the seed is afterwards done by hand; for if done by a flail, the seed is cleaned with difficulty; and the pieces of the stalk, which then become intermixed with the seed, give an offensive taste to the oil. The seed may be preserved a long time, but requires to be aired. The oil of the poppy is used both for food and light, and is considered a fifth more valuable than that of the colza. The cakes, remaining after the expression of the oil, are valuable for the fatting of swine; and the stalks for fuel. The ashes, which remain after burning it, are of the best kind for manure. If the seed be pressed in a mill used for the colza or other oil, the greatest attention must be paid to cleaning it. The oil expressed in cold weather is much superior in quality to that obtained in warm weather, and the two must not be mixed. The great enemies of the poppy are the field-mice, which eat off the stalks while in a green state, and then destroy the heads. The birds likewise plunder a great deal of the seed.

4. **Cameline.**—Another plant, called *Cameline*[1], is cultivated, when, for example, the colza fails, as it ripens its seed in three months. The oil is not so valuable as the colza, as it has a bad smell. The plant is not extensively cultivated; but it succeeds well in sandy and inferior land. The stalks of the plant are used for brooms, and some persons cultivate it for this object.

5. **White Mustard.**—The white mustard is sometimes cultivated both for the medicinal qualities of its seed and the oil expressed from it, which, though useful for many purposes, is not suitable for human food. The great objection to the cultivation of this class of plants is, that it fills the ground with seed which germinates in succeeding years, and is with difficulty eradicated. It is sometimes subject to mildew or rust. It ripens in about fifteen or sixteen weeks. It is liable to be lodged; but this does not ordinarily injure the seed. The plant is eaten as a salad; and it is given to cattle as a change of food, when their appetites become capricious, and require to be quickened.

6. **Flax.**—Flax is a great crop in many of the northern countries of Europe. It has been largely cultivated in Flan-

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[1] *Myagrum Sativum.*

ders, both for its fibre and oil. It has been for a long period an important article of commerce, and probably in no country has its culture been carried to such perfection. The value of the crop, and the extraordinary difference in the value of different qualities, amounting in some cases to full one hundred per cent., show the attention it demands, and how liberally it recompenses extraordinary care.

Flax will grow on various soils, but is not indifferent to the character of the soil on which it is cultivated. It requires a rich sandy loam, and one thoroughly manured. It is advisable, however, with the exceptions to which I shall refer, that the soil should be enriched by previous manuring, rather than in the year of its being sowed. The Flemish farmers make flax a crop in their regular rotation, occurring one in seven or eight years; and the manuring of their previous crops has reference to the flax crop, which is to succeed.

There are generally stated to be two kinds of flax. The difference does not appear so great, however, but that they may occasionally run into each other. There is a kind which runs up on a single stalk, which is generally preferred, on account of its producing a finer fibre; there is another, of a coarser kind, which branches out at the top, like a tree. They make a distinction in Flanders, likewise, between the plants which bear a close, and those which produce an open or gaping capsule or seed-vessel, the latter being preferred. Experiments have been made in Germany with seed brought from South Italy. The seeds were beautiful, and brilliant, and large, yet the plant attained a comparatively small height.

The Flemish farmers approve of changing their seed frequently. It is said that a crop from seed which has been twice sown in Belgium is inferior in quantity, owing to this circumstance. I am an unbeliever in the deterioration of any plant on account of continuing the seed, where proper pains are taken to get, by selection and care, the best seed only from that plant. The seed preferred in Flanders is the seed brought from Riga. There are other places, however, from which seed is brought, the fibre produced from which is said to be finer than that from Riga.

The seed to be chosen should be heavy and brilliant, of a gold colour, or a clear brown, and especially clean. It may be tried in water; and if much of it floats upon the surface, it is owing to the imperfection of the seed. It may be tried by throwing some little into the fire, to determine its oily properties; and it may be laid upon a wet blanket or cloth, to determine its germinative powers. Seed which is black, or seed which has been much heated, is wholly unfit for sowing.

The ground for flax cannot be prepared with too much care. A very fine crop of flax is often obtained on grass land, recently turned over, and this even without manure. The land in this case is carefully ploughed, rolled, lightly harrowed, and then sowed, and the seed lightly harrowed or brushed in. The crop which precedes flax is often oats or rye, but especially potatoes. The land, if in stubble or in potatoes, is carefully ploughed in the autumn, and then twice again in the spring; and it requires to be most thoroughly cleaned, and kept clean of weeds.

It is commonly sown thickly. Thick sowing tends to render the stalks fine and straight, without branching. One hundred and sixty pounds of seed is the usual allowance to an acre, which seems a large quantity. The land is sometimes manured in the year in which it is sown. In this case it is ploughed early, say in March, and thoroughly wrought, and then rolled smooth and hard. The land is then manured with thirty bushels per acre of peat ashes from Holland, or what is called Dutch ashes, and with a good dressing of liquid manure from the urine cistern, in which the cakes of colza have been dissolved; and this is mixed, likewise, with some manure from the privies. This makes a strong dressing; the land is then harrowed; the seed sown, and lightly brushed in with a bush-harrow, as there is always danger of covering the seed too deeply. Horse manure must not be used for this crop. The effect of marl used as a manure for flax is to injure the colour. Pigeons' dung, or what is called columbine, and which includes also the manure of the poultry yard, is pronounced an excellent manure. It is plain that these manures do not favour the production of weeds, as is commonly the case with barn-yard manure, and consequently is much to be preferred. In the neighbourhood of Courtray, where much the best flax is grown, they use great quantities of the liquid manure, with the rape cakes freely intermixed. A thousand gallons of this liquid manure, with a thousand rape cakes dissolved in it, are sometimes applied to an acre. Besides other crops, flax is said to follow to great advantage a crop of hemp, which is always highly manured, and kept perfectly clean. The dung of sheep is much valued for the flax crop; and especially where sheep have been folded on the land. The general opinion is, that high manuring produces a coarse flax; light manuring produces a flax of a fine fibre. It requires a deep culture, as the roots are supposed to penetrate to a depth equal to half the height, and the flax root has been traced much farther than this.

The best flax is produced at Courtray; and it is said that the same pains or manuring will not produce nearly as good in other places: this seems to imply some unascertained quality in the soil, peculiarly favourable to its growth.

The time of sowing flax must be somewhat regulated by the climate or position of the place. It is sown in March, and sometimes as late as May. The earlier sowing is advised, though in the countries of a high northern latitude the rapidity of vegetation compensates to a degree for the shortness of the season. Ordinarily in fifteen days after the sowing of the seed the field will require to be weeded. This cannot be too thoroughly performed, and is done by women and children, on their knees, working against the wind, that it may raise the plants which have been pressed down.

Flax is often liable to be lodged, especially if the growth be rapid. Great pains are sometimes taken to prevent this, by placing stakes in line in different parts of the field, and laying poles or bars along upon them, which serve to keep the plant from falling over.

If flax of an extraordinary fineness is required, it is pulled before the perfect ripening of the seed; the superior fineness of the fibre is considered as a compensation for the loss of the seed. But if otherwise, an early is preferred to a late gathering; as the longer it is left to stand, the coarser and harder becomes the fibre. The seed is generally taken off by an iron-teeth comb, made for the purpose, as soon as the flax is harvested; or the whole is stowed away in a barn, to be taken off at pleasure. When the flax is stowed away in a barn, and the seed not taken off until the succeeding winter or spring, it acquires a ripeness which gives it a superior value. After the seed is taken off, the flax is set up in the field in a sort of windrow, the roots upon the ground, and the tops inclined to each other, until it is sufficiently dried to be placed away in a barn, or stacked with the roots out, or steeped, preparatory to being dressed for the market. The bright and beautiful silvery colour of the flax is of great importance, and so is the fineness of the fibre; and all pains are directed to secure these objects.

There are several modes of steeping, or what is termed rotting the flax, that is, destroying the bark of the plant so as to clean the fibre. It is sometimes dew-rotted, that is, left upon the grass, being occasionally turned; it is sometimes rotted in stagnant water; it is sometimes rotted in running water. In Flanders there are persons who are employed as regular steepers of flax; and when the farmer sells his crop of flax before it is dressed to the merchant or manufacturer, these persons dress and prepare it for the market. The inhabitants of Courtray steep their flax in the water of the river Lys, drawing off to the side in an artificial basin, of sufficient depth and width, water sufficient for their purpose. The flax is set upright, with the roots downwards, in a sort of hurdle or basket, and it is with great pains retained in its upright position, as being necessary to prevent its becoming discoloured. They are careful to keep the roots at least a foot from the ground, or bottom of the pool. In many cases, instead of water being drawn from the river into a pool or basin, the flax is placed upright in hurdles to prevent its floating away, directly in the running stream, with planks and weights in all cases to keep it under the water, as the tops are longer in becoming macerated than the bottoms; and where they are not sufficiently rotted, a considerable loss is experienced. In this case, of course, fresh water is continually supplied to the flax; and the process is completed sooner or later, according to the temperature of the weather. Great skill is required to determine the precise time when the process is finished, and the flax removed from the water, as a few hours are said in such case to make an important difference in the colour of the flax. This must be matter of experience rather than of written instruction. In other cases, a pool or cistern of water is formed in a field, in which the flax is immersed, fixed upright, and the bottoms of the plants not touching the bottom of the cistern; and so arranged, that this water can be drawn off and replenished with clean water. It is said that in this way the cleaned flax has more weight than in any other, amounting it is said over some methods employed to ten per cent. This method was at one time considered a valuable discovery in Flanders. It is clearly important in all cases that the water should have no foreign substance in it, which would be likely to give a colouring to the flax. I have already mentioned the value of the water in which flax has been steeped as a manure to land, having seen the most beneficial effects from it. I am informed that a method has been adopted for getting the bark off the flax by steaming the plant, in which case the whole is accomplished in seventy hours, but I am not sufficiently informed to speak of it with confidence. The flax being thus rotted, the remaining operations through which it passes are well understood. The operations of heckling and swingling flax, which were formerly performed wholly by hand, are now performed by machinery moved either by steam or water; but it does not enter into my plan to describe these machines.

The seed of flax is of great importance in Flanders for the manufacture of oil. About seven bushels of seed are rated as the ordinary yield from an acre of land. This seems a very small product. The seed, when first taken from the stalks, is carefully dried and kept in sacks, until it is beyond the danger of being heated. The cakes from the pressed flax seed are highly valued for the fatting of cattle; and the seed itself being converted into jelly, is capable of being used in this way to great advantage. Indeed, as far as my own experience goes, I know no single article superior to it for cattle or for sheep.

In Flanders they sometimes sow clover or carrots among the flax, from which they get a crop after that is removed. This should not be done in any event until after the first weeding of the flax. The practice is generally approved. That it is to a degree prejudicial to the flax crop, there can be little doubt; but whether the profits of the clover or the carrots would more than compensate the lessening of the crop of flax, is a matter upon which there exists a diversity of judgment, and, in different cases, undoubtedly a diversity of results.

7. Hemp.—The cultivation of hemp prevails to a considerable extent in Flanders, and is expensive in the preparation

of the land, and the quantity of manure required. The value of the crop is considerable: the land being well cultivated and highly manured, is in a condition for two or three successive crops of grain.

The soil required for hemp is a strong, rich, moist loam, a deep alluvion; and it needs to be deeply cultivated and liberally manured. It is not unusual to plough it eight to ten inches deep, or to trench it with a spade a foot deep or more; and it should be finely divided and tilled. It is ploughed in the autumn, and then again twice in the spring; but it must not be wrought when it is wet, which indeed may be laid down as a universal rule. A sandy clay loam may be considered as best adapted to this culture. It likes a warm exposure and low ground. It succeeds well after clover or potatoes; and in some places it comes as often on the same ground as every second or third year.

The manure which best suits hemp, is horse or sheep manure. If the manure is coarse and strawy, it is ploughed in, and often by the first ploughing in the autumn; but if well rotted, it is applied in the spring, and near or at the time of sowing. It requires a warm manure; though the manure of cows, when about a third part is added of night-soil, or manure from the urine cistern, is an excellent application. The manure of pigeons and poultry, ashes, and the cleaning of streets, are much valued. To give a rapid growth to the plant, the manure must be in a condition, that is, well rotted or short, to be immediately taken up by the plant; and with respect to hemp, there is little danger from the seeds of weeds in the manure, as the luxuriant growth of the hemp will overpower them.

The seed is sown ordinarily about the middle, or within the last fortnight of May, and sometimes not until June. The seed requires to be watched against the birds; for even after it has made its appearance above ground, they will pull up the plants and take the seed. The plants are to be thinned out to a distance of three or four inches; but if the land be very rich, to a greater or double that distance. If it is desired to grow a fine hemp for twine, the sowing should be thick; if for large ropes and cables, it may be sowed more sparingly.

The gathering of the hemp is made ordinarily at two different times. There will be found in the field what are called the male and the female plants. Both in Belgium and in France, by a misnomer, the plant bearing the seed is called the male plant, and the plant bearing the flowers for the impregnation of the flowers upon the seed-bearing plant is called the male hemp. It is of no great importance by what term they are designated, provided the difference is understood. The plants which do not bear seed are to be pulled from the field some weeks before the seed-bearing plants; they at that time will give a fine fibre, but if left until the ripening of the seed, they become of little or no value. The time for pulling them is when the flowers of the non-seed-bearing plants have been long enough unfolded to shed their pollen upon the male plants, and the top of the stalk becomes of a yellow colour, and the part towards the root is bleached. The ripeness of the seed-bearing plants is determined by the maturity of the seed, and the fading colour of the stem. The hemp, being pulled, is tied in small bundles; and, after being sufficiently dried by being set up in the sun, the seed is beaten or combed off, and the plant is prepared for steeping or rotting. The hemp pulled first requires not more than eight or ten days for rotting; the last pulled, which is drawn of course when the weather has become colder, is sometimes kept in the water two months; and it is well for it to remain until the water freezes. The mode of steeping does not differ much from that of flax, excepting that it is not deemed necessary to set it upright in the water, and that it is done in a pool or basin instead of the river. The colour of the fibre of hemp is obviously of little importance compared with that of flax, though some of the finest of hemp is sometimes mixed with flax for the making of coarse linens.

Hemp, too, like flax, is sometimes dew-rotted upon the ground, where it is thinly spread out, and occasionally turned. That which is dew-rotted has a superior whiteness and fineness of fibre to that which is steeped, but is not so durable. This dew-rotted hemp is therefore preferred for twine, and the other kind for cables and strong cordage. The early pulled hemp should not be rotted upon the grass, but upon stubble; and it is believed by some farmers, that where it is spread upon a rye-stubble to be dew-rotted, it acquires a whiteness above that by any other process. The seed-bearing hemp, when dew-rotted upon grass, must be spread so thinly that one stalk should scarcely touch another.

The farmers of one of the best cultivated districts in Flanders, the Pays de Waes, are averse to planting hemp, because of the great quantity of manure which it requires; but, with the addition of a moderate manuring, they get excellent wheat after it, and sometimes carrots are sowed after hemp, and a superb crop of flax is taken from the same ground after the carrots. Two great advantages are said to come from the cultivation of hemp; the weeds are stifled, and the leaves, which fall from the stalks, serve to enrich the land.

The quantity of seed sowed to an acre is about half a bushel; and it is advisable to sow it in narrow beds, that when the non-seed-bearing stalks are pulled, the seed-bearing stalks may not be interfered with. Sometimes a crop of rye or wheat is sown among the hemp plants, while standing, and the extraction of the non-seed-bearing plant serves to cover it. This saves a ploughing.

At the harvest, the plant is usually drawn by the roots, though sometimes cut with a sickle or a knife, and laid on the ground to be dried. The hemp is said to be of a superior quality if thoroughly dried before it is put in the steep. The ends of the seed-bearing hemp are sometimes beaten over the edges of the head of an open barrel, as the seed which comes off in this way most easily is, of course, the most ripe, and the best for sowing. The seed which first comes off in this case is taken for this purpose.

The roots of the hemp before dew-rotting are cut off with a hatchet, and used for fuel. In pulling hemp, it is important so far to select the stalks as to bring together those which are of the same length to be tied up in the same bundle. The hemp, after being steeped, must be thoroughly dried; and this is done in some parts of Germany by a kiln of simple construction for that purpose, which saves much time. The hemp, after being dried, is broken by a machine formed by one heavy stone rolling over another, which breaks the bark; and sometimes by mallets, and then the bark is picked off by the hand; a slow process, and prejudicial to the health of the labourers from the dust which fills the room where this is done.

The produce of an acre of hemp is ordinarily about 350lbs., and of the seed from thirty to thirty-five bushels.

There are several other crops cultivated extensively in Flanders; but my object is not so much to give a specific and detailed account of the mode of cultivation of these crops as the general features of the cultivation. Tobacco and hops are grown to a considerable extent; and likewise several plants valuable for their colouring or dyeing properties, such as Woad or Pastel, Weld, and Madder.

8. Tobacco.—Tobacco is cultivated as an article of large consumption and of commerce. It is quite remarkable that a plant so odious and offensive as this, in no respect conducive to health, and in most cases positively injurious, and so nauseous and repugnant to an unaccustomed taste until habit has overcome this repugnance, should have acquired

such a hold, that it has become with a large portion of mankind almost a necessary of life. There is no hope of a reformation in this respect, and the use is constantly extending itself.

There are two kinds of tobacco cultivated in Flanders; that of Virginia and that of Turkey; the former is esteemed greatly superior to the latter.

It has its place in the rotation of many farmers, occurring sometimes once in four, and sometimes twice in seven years. It will grow well upon most soils, excepting a heavy clay or a dry sand, or a wet soil; but it requires laborious cultivation and abundant manuring. The crop is stated to be 4000 lbs.; but this much exceeds the amount grown to an acre under the best cultivation which I have known in the United States; 2000 lbs. would, I think, be considered there a large crop, though I have known an average crop of 2700 lbs. grown on several acres under circumstances peculiarly favourable.

The soil is ploughed, and the manure ploughed in, in the autumn, and again ploughed and laboured in the spring. The manures used are cow and pigs' manure, and likewise the manure of sheep, which is deemed peculiarly favourable. Malt-dust from the breweries is much valued; and very large dressings of rape cake, sometimes in powder and sometimes dissolved in the urine cistern, are extensively used. If fœcal matter is mixed with this, it is essentially improved for this object. The manure of horses, even the urine of horses, is objectionable, as giving a bad taste to the tobacco. What worse taste can be given to it than its ordinary taste, it would be difficult to imagine.

The seed is first sown in a nursery-bed, in a warm and sheltered exposure, in March; the nursery-bed should be well-wrought and manured; and, in case of danger of frost, the young plants require some protection either of bushes or of straw. The transplanting is usually made with a dibble in

June, when the young plants have acquired a growth of six leaves. They are set out in rows two feet apart, and in the row the plants are fourteen inches apart. In about fourteen days the plants require to be hoed, and the plantation to be kept clean of weeds. When the plants have acquired a height of ten or twelve leaves, they are then, as it is sometimes termed, stopped,—that is, the top-shoot is pinched off, so as to prevent its rising any higher; and all side shoots are broken off, so as to leave only one stalk. In this way the sap of the plant is thrown wholly into the leaves. The tobacco-plant is subject to be injured by frosts, especially in low grounds; and is likewise liable to rust, under which the leaves perish and fall to the ground. This depending, as is supposed, upon a bad exposure or a bad condition of the soil, as yet unascertained, no remedy has been discovered. I have not been able to learn that the tobacco-worm, so well known in the United States, and so destructive unless means are taken to remove it, is known in Europe. This is a large green caterpillar, found under the leaves; and sometimes a large drove of turkeys is sent into the plantation, who pick them off and regale themselves upon them. This is the nearest approach within my knowledge to the use of this weed among the inferior animals; the worms eat the tobacco; the turkeys eat the worms.

When the leaves begin to turn yellow, the harvest begins; they are picked off by hand close to the stalk, and, after a little exposure to the sun, are then tied up in bands and hung up under cover for perfect drying. When taken off they are sorted into three qualities: the first into the large leaves; the second composed of the leaves next in size; and the last of the leaves which have grown nearest the ground.

9. HOPS.—I know of nothing peculiar in the culture and management of hops in Flanders, excepting the production of sixteen hundred pounds of dried hops to an acre, which is

a very large yield. They are careful not to have the plantations of too large an extent, as it would prevent a free circulation of air; and they manure the ground most liberally with liquid manures. The hops are planted in hills six feet apart each way; and four plants to each hill. A trench is dug round the hill, which is filled with decomposed manure, and in some small measure earthed up. The usual operations of trimming and poling them follow. As no crop of hops is taken the first year, the intervals are occupied by cabbages and other plants.

A method has been recently invented and patented in England for drying or curing hops, by which it is stated that at least fifty per cent. of the fuel ordinarily used will be saved, and a much larger amount of the essential oil of the hops, the lupulin, will be retained in them. The furnace or kiln for drying them is of a peculiar construction; and the air used for drying them is made to pass over sulphuric acid or quick-lime, by which it is divested of its watery properties, and comes in upon the hops in a dry and decomposed state. The apparatus is deemed simple enough, and not extraordinarily expensive. The hops dried in this way have, it is stated, brought twenty-five per cent. more in the market than those cured by other methods. I have seen the plans for constructing the apparatus, but further experiments may be desired to determine its advantages. It is said to be applicable to other agricultural purposes, such as malting, and even the drying of hay, so as to expedite the process, and at the same time retain the rich juices of the herbage. It is difficult to conceive that it should be useful in this way upon any large scale. Most patent inventions, however, like patent medicines, are catholicons.

There are cultivated in Flanders, in France, and in Italy, several plants for the purpose of dyeing or colouring, such as woad, which is used for a blue dye, weld for yellow, and madder for red. I was once asked, what bearing had the colour of the trousers of a soldier of the French army, which are red, upon agriculture. The answer is obvious, so infinitely diversified and innumerable are the circumstances which affect the various relations and interests of social life.

10. MADDER[1].—Madder is one of the most important of all the plants used in dyeing, and is cultivated at great expense. It is two years, and sometimes three, before the crop is gathered. There are two kinds cultivated; the one with a quadrangular, the other with an hexagonal stem. The former is the most productive; the latter produces madder of the best quality.

The soil required for its production should be deep and rich; a clayey soil will produce good madder, but its working is difficult; a soil, therefore, in which sand enough prevails with the clay to render it friable, is that which is to be chosen. It must be deeply cultivated, as the roots, which constitute the value of the crop, run down very far. A plough will scarcely go deep enough, and the land should be trenched with a spade to the depth of at least three feet. Manure should be ploughed in and dug in until the whole bed becomes most thoroughly enriched. It is advised to plough in the solid manure in the autumn, and in the spring to apply liquid manure, urine and fœcal matter intermixed. Cow manure and stable manure are also applied with advantage; and the land should especially be rich from former cultivation, and from having been thoroughly cleaned of weeds. The manure should not only pervade the surface, but be buried deeply, that the roots may not want for nourishment as they go down.

Madder should be sowed in a nursery-bed in a garden, and the seed of the last year should be used, as seed of more than a year old germinates at a very late period after planting. It is well to lay the ground in beds three feet wide, to receive two rows of plants; or in five feet beds, to receive four rows of plants. The plants are to be set in line, a foot apart, and the rows at an equal distance. The intervals between the beds are to be shovelled out, and the ground kept loose by a spade until the second year, when the roots of the plants extend into the intervals, in which case they must not be disturbed; they must then be kept clean, but not dug. Holes may be made for setting the plants, either with a hoe or a spade; they must be taken from the nursery-bed, and immediately set out, and not allowed to get dry or withered in the air; they may be dipped in water when transplanted, and great care must be taken to prevent their being injured, and to place them fairly in the ground, bringing the earth and pressing it carefully down around them. Liquid manure may be applied with great advantage in the intervals between the beds. After the planting, it is well to water the plants; and they are to be kept clean, and the intervals kept loose by a narrow hoe or spade: the sprouts thrown out at the sides of the main stem may be bent down and covered with earth, so as to force the growth of the root In the autumn the plants should have a slight covering of strawy manure.

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[1] *Rubia Tinctorum Sativa.*

The madder which is not taken up until the third year produces much more, and of a better quality, than that which is gathered the second year; but the increased expense and rent of the land are seldom compensated by the increased product.

The harvesting is a work of much labour. The roots, which in a well-prepared soil extend to a great depth, must be taken up with much care, and without injury. Sometimes a plough is passed along the line, and then the work is finished by the spade, but generally it is wholly done by the spade; the intervals between the beds being dug out to the depth of two feet, and the plants carefully displaced and taken out by means of forks or narrow hoes. The plants lie upon the ground three or four days, in small heaps, in order to become dry, and in case of rain are covered with straw. They are then carefully housed, and afterwards dried in a kiln for the market. The excellent condition in which, under such cultivation, the land is left for other crops, is a considerable indemnity for the expense and trouble bestowed upon the crop of madder. The rich polders, or redeemed meadows, both in Holland and Flanders, are favourite spots for the cultivation of this crop.

11. WOAD[1].—This plant grows wild in various places, but is cultivated for its blue dye. Where indigo is not attainable, it takes its place; and where indigo is attainable, it is found advantageous to mix a portion of woad with indigo. The use of indigo, however, much interferes with the cultivation of woad. It is sown both in the autumn and spring. That which is sown in the autumn has the advantage of giving a larger crop of leaves, and of sooner getting out of the way of insects. The leaves constitute the value of the crop, and these are gathered sometimes thrice in a season, the first gathering being much the best. It requires a rich soil; and the particular kind of soil is not so important as that it should be deep, to admit of the free descent of the tap-root of the plant. Rich alluvions, which have been well drained, are particularly favourable to it. The land should be manured as well as for wheat; and, above all, it should be kept thoroughly clean. It succeeds well after grain or after potatoes. It may be sown in drills, or it may be grown in a nursery, and transplanted. The plants require to be from a foot to a foot and a half apart. The leaves are gathered when they begin to droop, and turn slightly yellow; they must be kept free from dirt, and when laid away must be

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[1] *Isatis Tinctoria.*

guarded against heat or fermentation. They are sometimes washed, to get rid of any dirt which may adhere to them; and a dry time must be taken for gathering.

After being gathered, they are crushed in a mill, resembling a tanner's bark-mill; they are then made into heaps, where they undergo a fermentation, great pains being taken to close any cracks which may appear in the crust of the heap: after this they are rolled into balls, twice as large as a man's fist, and are then pressed into the form of bricks; and thus are ready for the market. The profits of such cultivation must depend upon the state of trade, and the price of indigo. I found this plant cultivated extensively in one part of Lincolnshire, where a large mill had been recently erected for its preparation. The best woad is grown in the south of France, where it is largely cultivated.

12. WELD[1].—The weld is cultivated for its yellow colour. It is a plant which grows wild in many places, and the smaller kind is known in the gardens as mignonette. It requires a soil dry, calcareous, and well cultivated. It will grow well upon a sandy clay loam. Upon a very rich soil the stems will be proportionally strong and large, but the colouring matter not so good; upon a poor soil it will not pay the expenses of cultivation; a soil of medium fertility is to be preferred. It should be sown very early in the spring, and the ground should be well cultivated in the previous autumn. It does not require manure when sown upon a soil previously well cultivated and clean. The seed must be covered as lightly as possible, and it is best sowed in line. It will require to be carefully weeded; and when the leaves begin to turn yellow, it should be gathered. In a sandy soil it may be pulled with the roots; in a clay soil, where the dirt would adhere to the roots, it should be reaped close to the

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[1] *Reseda luteola.*

ground with a sickle. The plants which are designed for seed should be allowed to remain until the seed is perfectly matured. Fresh seed is greatly preferred to seed more than one year old, which often fails to come up; and when sown, on account of the smallness of the seed, it is recommended to mix it with some fine sand. The plants when gathered are to be dried in the sun, and then tied up in small bundles, so overlaying them, that the tops of the plants shall be turned in upon each other, and the roots project at each end of the sheaf. They must then be put away in an airy and dry place, and are ready for sale. It may be cultivated on the same land once in eight years.

13. Carrots.—I must not quit the crops common in Flanders, without referring to the culture of the white carrot, which is vastly more productive than other sorts. This is sometimes sowed among rye or wheat, or colza or flax, after the last cleaning, and a small crop is obtained in this way, but often at the expense of the crop among which it is sown. When sowed as a separate crop, they speak of twenty tons to an acre, or eight hundred bushels. They require a comparatively light and dry soil; they bear high manuring and deep cultivation; and are considered a profitable crop.

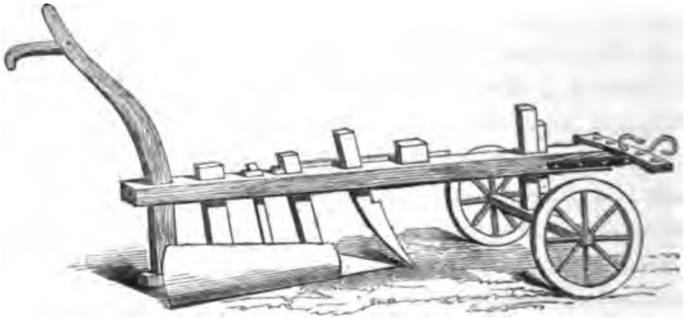
I shall take the liberty of repeating here what I have said in another place. The land, after being fully prepared by manuring and fine tilth, should remain until the first crop of weeds comes up, and should be lightly ploughed, in order to destroy these. Furrows should then be made upon the field, into which the manure should be placed, and then a back furrow slice turned each way upon this open furrow, so as to form a ridge directly over the manure. These ridges should be twenty or twenty-seven inches apart. On the top of these ridges, which should be smoothed off carefully, the carrot seed should be sowed in double rows ten inches apart, and as straightly as possible. The carrot seed should be sprouted in wet sand, before sowing, and should early be weeded. The land may then be ploughed between the rows, and kept clean with a hoe. They must be thinned out in the row to about six inches asunder. When ready to be taken up, by running a plough directly by the side of the row of carrots, they are gathered with little trouble.

I have now gone through the principal crops grown in continental husbandry, and though not undertaking to give a full detail of the culture, yet I have given all the peculiarities which distinguish any mode of culture, and those general rules and principles which are universally applicable.

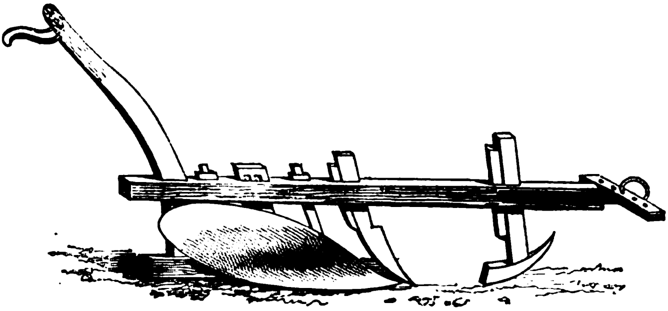
CXXXVII. IMPLEMENTS OF HUSBANDRY.

In Paris at the Conservatory of Arts and Trades, at Brussels, at Utrecht, I found extensive collections of agricultural implements and models of agricultural tools and machinery. These embraced many of the most improved implements to be found in England or the United States. It may excite a smile of surprise with an Englishman, that I speak of the United States in this connexion. But I have seen nothing on the Continent or in Great Britain equal to the collections of agricultural implements which are to be found, for example, in Boston, United States. The English implements are usually clumsy, heavy, and inordinately expensive. In treating of British Husbandry, I have given an account of some of the best of them. They at least answer the purposes of the ingenious mechanics, who understand very well when they have got their pail under a cow with a full udder, and how in the most agreeable manner to abstract the gold from the pockets of enthusiastic agricultural amateurs. Like the Flemish cows, they are carefully fed, not to say flattered, while being milked; and finding tools and implements for every operation, and adapted to all possible shades of difference in the manner of performing it, imagine they have only to purchase the tool to have the operation accomplished. In general they are compelled to learn that it is not so much the tool, as the man who holds it, upon which they are to rely for the proper execution of the work. Of this the Flemings are a striking example; for it is impossible to find agricultural operations better executed, and with fewer and more simple implements.

Two ploughs are much celebrated in Flanders, one called the Walloon plough with wheels to the beam, of which I subjoin a sketch, and which is much used for ploughing deep in heavy lands. It is used with two, three, or four horses, according to the nature of the soil, or the depth to which it is desired to go.

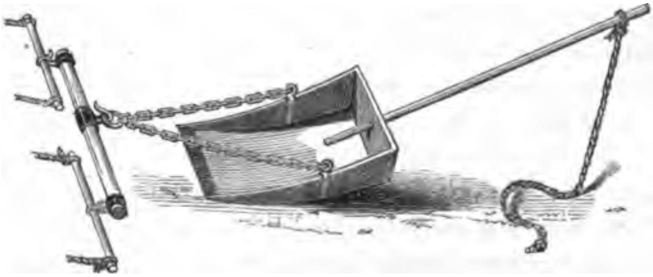


The other is of a lighter description, and is much esteemed as the Dutch plough. It is introduced into France, and there most highly approved. For light lands it is used with one horse, but ordinarily with two. What I have sometimes seen called the Dutch plough has had the mould-board so curved, or rather almost concave, as to offer great resistance; and rather to press the dirt as if with the hollow of the hand, than to turn it over. The common Flemish plough is undoubtedly an excellent implement. It has a shoe or regulator attached to the beam in front, by which the depth of the furrow is regulated. A plate of it is subjoined. The Flemings value it not only for raising and inverting the land, but for pulverizing it at the same time.



In the harrows and rollers used in Flanders I saw nothing peculiar. They have bush harrows, and harrows with teeth of iron and of wood.

The instrument, which is deemed peculiarly Flemish, is the *mouldebart*, of which I annex a plate. It is designed for the speedy removal of earth, when it is not required to transport it to a great distance. The horses or oxen are attached to this implement which immediately dips itself full of dirt, and when full, the handles are then pressed down that it may slide easily over the ground. When it reaches the place of deposit, the handles are raised, and it empties itself; and the string, which is constantly held by the workman who guides it, is designed to pull it back after it is emptied. It is thus prepared to take up another load. It is a most useful instrument, and effects a great deal of work with a small expense of labour in a short time. It has been used many years in the United States, and is there called an ox-shovel.



The plough which I saw frequently used in Italy was without a mould-board, and its share resembled the bowl of an inverted teaspoon, only more flat. It simply stirred the ground, but did not invert it.

The spade is an instrument much used among the small farmers of Flanders; and in the best cultivated districts, such as the Pays de Waes, they deem it necessary once in five or six years to trench their land completely to the depth of fifteen or seventeen inches with the spade.

I saw nothing in the carts, waggons, or vehicles in use on the Continent in any way to recommend them either to English or American farmers. Nothing, however, can be more complete than the fitting out of a Flemish or Dutch farmer's team. The equipments in France and Italy are in general wretched in the extreme. In Italy and in Switzerland, oxen and cows are principally used for draft. In Italy the breed of cattle is extremely beautiful in appearance. In Italy, oxen are often brought out upon the roads to assist in dragging the coaches up their steep hills. They ordinarily draw by the horns or forehead; but where a yoke is used over the neck, I have found a basket of stones hung at the centre to keep it down, that it might not impede the breathing of the cattle. Instead of bows, there were ropes round the necks of the cattle.

The Dutch collar for draft horses has been the subject of much improvement, and the horses used in the Belgian artillery are said to have derived an immense advantage from its improved character. The first object has been to avoid, as much as possible, a horizontal draft, and, therefore, the point of attaching the chain or trace is placed high on the collar, so that it may not affect the breathing of the animal; the second, to avoid galling the neck of the horse, and for this reason the collars are made open to buckle at the top, by which means they can be better adjusted to the neck of the animal. Great stress, and I believe very justly, is laid upon having the collars made so as to open at one end at pleasure.

CXXXVIII. SPADE HUSBANDRY.

An implement which has accomplished an immense amount in some parts of continental Europe, is the spade; and when we reflect upon the actual amount of labour effected by this simple tool, managed by the human hand alone, the elevations which have been levelled, the canals which have been dug, and the mighty embankments which have been raised, one is filled with astonishment at the great effects which are brought about by the most simple means, and at the vast results of combined and persevering labour.

A great amount of land is cultivated by the spade in Belgium, Holland, France, and Germany. Indeed, vast extents of land, especially in the vine-growing districts, on the steep acclivities and on the summits of high hills which are cultivated, are entirely inaccessible to horses or cattle. The ground is tilled by the spade; the manure is carried up, and the produce is brought down on the backs of men or women. It is stated in a statistical work, now in the course of publication in France, that not less than forty millions of acres in that country are cultivated by the spade. This strikes me as an over-statement; yet the amount is, doubtless, very considerable. In Flanders the cultivation is mixed, with the spade and the plough; the land for grain crops is wrought with the plough and laid in beds or stitches, and the intervals are dug out with the spade, and the seed sown on the beds is covered with the dirt thrown out of these intervals. This is all done with the greatest care, and this is the occasion of the extreme neatness and exactness which appears in their cultivation.

In the case of very small farms of a few acres, all the work is executed by the spade or the hoe. It may interest my readers to see the calculation made by the late Rev. Mr. Rham, a gentleman highly esteemed for his agricultural knowledge, and his zeal in agricultural improvements, as to the amount of produce which may be obtained "from fifteen Ghent acres of light land and moderate fertility, which should be cultivated by the spade, with the help of a horse and cart; and will maintain four milch cows, and a heifer; a horse, two or three hogs, and a couple of young pigs; sending to market, or consuming in the family, the following produce, deducting seed:—

90 bushels of wheat.
90 „ rye.
30 „ buckwheat.
100 „ oats, leaving 20 bushels for the horse.
An acre of flax.
60 bushels of rape seed.
8 cwt. of butter, from four cows.
2 fat hogs.
A heifer and two calves, sold annually."

This is an extraordinary amount, and yet I have no doubt it may be realized.

I am not about to enter into a comparison of spade husbandry with that carried on by the plough, and the help of brute labour; but there are many cases in which, owing to the superabundance, and consequent cheapness of human labour, it may present a fortunate alternative. It is stated to require the labour of a man sixteen days to dig an acre, and thirty-two days to trench it, which would be going two spits deep. Labour in Flanders is about ten pence, or twenty cents a day, without feed, which would render it much less expensive than ploughing.

In cultivating land with brute labour, it is to be remembered that on few small farms can a team be kept constantly at labour; but the expense of the keep goes on whether the team labours or not. The cultivation by a spade is much more thorough than by a plough; much less seed is required, and much better crops are produced. A bushel and a quarter of wheat to an acre is ample, because every seed is carefully covered, and thus secured from the birds, and buried only at such a depth that it rises easily. The cultivation is much cleaner from weeds, and the manure is more thoroughly intermixed with the soil. The land is made friable, and the deep cultivation gives the roots of the plant ample opportunity to expand themselves. The beneficial effects of a good trenching will continue for five or six years. How far it may be expedient to adopt it on any large scale, must depend on a variety of obvious circumstances, which in different situations must greatly vary. The expense of keeping such teams of horses as are kept in England, and in many parts of the Continent—I speak particularly as to their consumption of food—to say nothing of their equipments and deterioration in value, is enormous. It seems the great drawback in England to a farmer's prosperity. What might be accomplished where a superabundance of human labour exists, what should be done with a starving population around you, anxious to be employed, and willing to work, are for the consideration of those who find themselves placed in these painful circumstances. Such is the sad condition of many parts of the European continent. The example of a Flemish farmer supporting himself, and wife, and three children, keeping a cow, and fatting a hog, upon the produce of two and a half acres of land; and selling, for various purposes, the produce of three and a half other acres, he being able, with the help of his wife and children, to cultivate well the whole six acres, and to have a great deal of time left for other purposes, is, I am assured, often to be found in Belgium, and strikingly illustrates the success of quiet and patient industry, joined to temperance and economy.

CXXXIX. LIVE STOCK.

In respect to the live stock of the Continent, a traveller perceives at once that, with the exception of horses, little attention has been paid to the improvement of the different breeds. Perhaps I should except sheep likewise, as I shall presently show. In this respect England distances all other countries within my observation; and has displayed a skill, perseverance, enterprise, and success, which are admirable; and which, in enormous prices, have been liberally compensated. A thousand guineas for a bull, six hundred guineas for a cow, or three hundred guineas a year for the service of a ram, ring in one's ears like music from the regions of romance. The symmetry of proportion, and the extraordinary degree of fatness to which some animals are forced, as may be seen particularly at the Smithfield Christmas show, in London, and the extreme beauty of the improved stock of England, are most remarkable. Aptitude to fatten, early maturity, and great weight of carcase, in proportion to the age, and the amount or cost of the food required, are points of great value in any race of animals which are designed for food. But beauty, either of form or colour, has only an imaginary value, and no necessary connexion with its product, either in beef or milk; and the extreme obesity of many prize animals is often obtained at an expense to the farmer or amateur much beyond any price which the animal is likely to command in the market. Early maturity is a point of great importance; for, excepting where animals are kept for labour, animals kept a day beyond their readiness for a fair market, are almost always kept at a loss. The secret of profit is in general in a quick exchange. I have known a farmer to weigh repeatedly two fattening oxen of fine thrift, and size, and extreme fatness, and he discovered that, for a whole month before they were sent to market, they had not gained a single pound. They appear to have reached their acmè, beyond which they could not be forced. It is a curious fact in regard to the human animal, that in a condition of health no change of diet and no abundance of diet ever carries him beyond a certain point; so that every adult man has what he terms his own weight, which does not vary for years. Whether an analogy to this fact is to be found in the inferior animals, would, as far as it is possible to be ascertained, be a curious and useful inquiry. Ordinarily, I admit, not always, animals consume in proportion to their size. I believe it will be found, in general, that two small, or medium-sized animals, of good constitution and thrift, pay the farmer better, in proportion to the amount of food consumed, than one large animal, which would give an equal or superior weight. The English farmers generally consider the small Highland cattle the most profitable for fattening. We know certainly that the milking properties of cows do not always bear a proportion to their size. The two best cows which I have known—one making 19¼lbs. of butter in a week, and more than 480lbs. in a year; and the other having produced more than 20lbs. in a week—were two medium-sized cows of the North Devonshire breed; and it seems an established prejudice, if so it must be called, that fatness, and the abundant secretion of milk, in the same animal, at the same time, are to a degree incompatible with each other.

1. Oxen and Cows.—I saw some very large oxen from Normandy in a fat condition on exhibition at Poissy. The cattle, however, most admired on that occasion were a cross of the improved Durham short-horn with some of the best breeds of the country.

The cows, as met with ordinarily in France, are inferior. They show in the early part of the season the effects of bad keeping in winter, and appear scarcely to recover from it during the season. The cows, at several private establishments which I visited, were admirable for their milking properties, but of no particular race; though at Grignon, at Petit-Bourg, and generally, I found the Swiss cows held in high estimation. The Dutch cows have been a long time celebrated for their abundance of milk, which does not surprise one in looking at the rich polders in which in summer they are fed, and where they are often seen covered with a cloth as a protection against both the dampness and the cold. Being unacquainted with the Dutch language, I found it difficult to get as particular information as I desired. Radcliffe, in his book on Flanders, says, that "they are fair milkers; but in this respect nothing remarkable, the average quantity, excepting in the grass districts, where it is *infinitely* greater, being computed at about seven quarts each cow in the twenty-four hours, through summer and winter." I quote this passage for two reasons; first, to show how loosely many people speak and write on such subjects, for one is wholly at a loss to know how much a product *infinitely* greater than seven quarts may be supposed to be; and next, to say that an average yield of seven quarts per day winter and summer is a very great yield, and is seldom equalled. There is another report of a farmer at the Hague, furnished to Sir John Sinclair, where the milk establishment of forty cows produced only about three quarts per day to each cow throughout the year.

The produce of a Dutch cow is rated at about 80 lbs. of butter, and 180 lbs. of whole-milk cheese, in a year, which certainly is not an extraordinarily large amount. They are generally of a black and white colour. In some cases they are milked three times in a day. In the greater part of Flanders I found them soiled upon clover or vetches, but principally clover; in Holland, they remain in the pasture all summer, where they are milked; but in winter they make a part of the family, and, in truth, live in the common eating-room of the family, it being a part of the main house.

The Swiss cows, as far as they have come under my observation, are to be considered of two kinds; the cows ordinarily kept on the common farms, and the mountain cows. The cows I found at Hofwyl are, from appearance and the accounts I received of them, the very finest of their kind. They are large, but not tall; broad in the back, full and square behind; fine boned, and with large udders, giving great quantities of milk. It is difficult, especially at any distance of time, and when innumerable objects are passing before the mind, to compare two objects, unless they are present; but I think I have never seen finer animals of the kind. The race is known as the Cimmenthal; and undoubtedly great pains have been taken in their selection and management.

I am at a loss to state the amount of milk given, or butter produced by these cows, because I do not know the capacity of the Swiss *measure;* but they are evidently deep milkers, and as well as I could understand they give from sixteen to twenty-eight quarts of milk per day, and about two hundred pounds of butter by the year. These cows were reported to me to weigh from 700 to 1200 lbs.; they were exceedingly broad and round; short and fine in the leg; in high condition, and extremely well covered; and in their whole appearance excelled by none which I have seen. I saw many of these fine animals for sale in the cattle-market at Berne.

There is another kind in Switzerland, which may be called the mountain cow, because I found them principally in the most hilly districts of the country. These were a small-sized animal of beautiful form, small limbs, exceedingly light of foot, evidently fitted to climb hills and precipices, and with eyes as bright as those of a gazelle, and not unlike a deer in their movements. These cows did not promise much in milk.

2. Goats.—In Switzerland, I found in the mountainous

districts large herds of goats, who are brought down from the mountains at night to be milked, and sent away again at daylight in the morning. Many small families kept one goat in their stables to supply the family with milk. They give about one pint of very rich and delicious milk each per day; sometimes more. Among the mountaineers of Ireland, near the lakes of Killarney, I found many families keeping goats for their milk; one family having as many as thirty. These were kept for the comfort and luxury of travellers, who visited these wild and picturesque regions. They are kept at a small expense, and were it not for their wandering and mischievous propensities, a milch goat would be a treasure in the family of a poor man. They might easily be fed by the waste vegetables of a poor man's garden or his frugal table; though in most of the poor families in Europe there are other mouths who claim first to be satisfied, and leave little waste of any kind. The milk of goats is rich, and is often recommended to invalids by high medical authority.

3. Asses.—Of all beasts of burden or draft in Europe, asses are, perhaps, the most common. Mules are bred and used largely in Spain, as I am informed; and I found them in the mountainous parts of Switzerland for the use of travellers in places and passes where carriages cannot be used, and where sureness of foot is particularly desired. But asses are every where common, and, for the purposes to which they are applied, are certainly most serviceable animals. They are in general of a small size, and cost from one to two pounds, or from five to ten dollars; their keep is of the hardest description, and they live to a great age. One was used constantly at Carisbrooke Castle, in the Isle of Wight, for drawing water from a very deep well seventy years, and he was replaced by another, who, when I was there, had been employed for many years. This most useful race of animals presents an example of the humiliating truth, that real substantial merit

does not always find its place in this world; that grateful and kind treatment does not always follow the services rendered; that abuse of power is too common a fault; and that exterior appearance and address are a surer passport to favour than solid and useful qualities. I cannot say, however, that this is without exception, for I found in some cases in Manchester, in England, among the Irish, the donkey living in the same room with the rest of the family, and sharing in their comforts, such as they were. Whether this was to be considered as an advance upon the usual companionship of an Irish cabin, I shall not determine. It shows at least an amiable trait of character to acknowledge our obligations, and quite in the equality and fraternity style of the times.

4. HORSES.—The Flemish horses have long been celebrated, and most deservedly so, as I have seen for their purpose no horses superior. In France and the Low Countries, horses exclusively are used for agricultural labour. In Flanders, two horses are allowed to fifty acres of land. In many cases the farms are accessible by canals, and manures are brought and produce carried away in boats, which, of course, on still waters are navigated at a small expense. The Flemish horses are of a medium size, compact, active, strong, and extremely well equipped; these farmers being very proud of their teams, as indeed they well may be. Add to this, they are groomed with extraordinary care. In my journey from Antwerp to Rotterdam by diligence, it is hardly possible to praise the horses too much, for their beauty, speed, and equipments.

The French work horses are admirable, and surprised me by their excellence. I refer particularly to a breed called the Picheron, bred in the interior of France, and used in the diligences and the omnibuses in Paris. The horses generally employed in these cases are unaltered, which clearly does not improve their temper or manners; they are rather under than over size; they are not groomed with much nicety, nor harnessed with any show; they are, however, kept in good condition, and almost exclusively for work; they are small-boned, well filled out, and extremely compact; their usual travelling gait, according to my experience, with immense loads, is from six to seven miles an hour: in the mail coaches in France, the rate of travelling is ten to twelve miles an hour; and no where are there more punctuality and despatch. The Flemish cart-horse, and the breed of French horses to which I have referred, would in my opinion prove a most valuable acquisition to the United States. The Flemish horse is slow in his movements; the French horse extremely active and vigorous; their ordinary height is fifteen and a half hands.

The mode of keeping horses differs much in different places. They are almost universally soiled in summer upon green food, either clover, vetches, or lucerne. I have already mentioned the case of a large contractor for conveying the mails, who was accustomed, besides straw and hay, to give rye bread in certain quantities, whenever the price of oats or other forage or provender made it upon a fair calculation expedient. For the health of the horses he much approved this food. His stock exceeded four hundred horses: oats are almost always deemed an expensive article; but the best farmers recommend to give them in the straw cut up. Carrots are much valued in Flanders for horses; and considerable quantities of beans are grown in France for horses, and given in a bruised or half-ground form. The Flemish give their horses what is called a white drink, that is, water mixed with some portion of rye or buck-wheat meal; and sometimes oil-cake is dissolved in it.

In some parts of Flanders, the allowance for a horse is in winter fifteen pounds of hay, ten pounds of straw, and seven pounds of oats per day. In summer, clover is given instead of hay and straw, seven pounds of oats, and their water whitened with rye-meal. In another district, in winter, about six quarts of oats, thirty-five pounds of hay, or in place of fifteen pounds of hay, about seventy pounds or a bushel of carrots. In summer, seven quarts of oats; eighty pounds of green clover are given. Instead of the oats, about four quarts of bruised beans are given. The Flemish are always anxious to have their horses in the best possible working condition. Excepting only the white drink, the keeping of the French horses does not materially differ from that of the Flemish. The advantages of cutting and mixing food for horses are universally acknowledged, on the score of economy to the farmer, and of utility to the animal fed.

5. Swine.—The swine are almost every where on the Continent, as far as I saw them, miserable; lank, lean, gaunt, and, if they have not a good point about them, they certainly have other points in great profusion. If it was a herd of such swine as one meets with continually in France and on the Continent, which were on one occasion driven into the sea and there perished, the owners certainly could have had little ground of complaint. At Grignon I saw some of the improved breeds of England introduced, and it is to be hoped that they will extend themselves; at present the race seems under a curse.

6. Sheep.—I shall say little of the sheep of the Continent. The sheep seen on the rich meadows in Holland are of a large size, with long coarse wool and a heavy fleece. The Saxony sheep are well known for the fineness of their wool, their small size, and their tenderness of constitution. I have already said that I found some excellent results at Grignon and Alfort from crossing the Merino with the South-Down, but sufficient time has not been had to decide whether it may be persevered in with advantage; a point by no means determined.

The pure Merino sheep, which were exhibited at Poissy from the farm of Mr. Gilbert, near Grignon, and originally of the stock at Rambouillet, were, beyond all comparison, the finest of the kind I have ever seen; and, I believe, of the very best kind of sheep, for the United States, which could be raised. They would weigh full twenty pounds a quarter when dressed; their wool is of a fine quality, and their fleeces extremely large and heavy. An intelligent American farmer who was with me at one time when I saw them, and on whose opinion, from his having been a great wool-grower, I should place much reliance, perfectly coincided with me in my impressions of the merits of these extraordinarily beautiful sheep. They are not so large or fat for mutton sheep as the Leicester or South-Down of England, in which country mutton, being a favourite food, is much more an object of demand than in the United States, but they are sufficiently large for mutton, and the superior fineness of their wool gives them a peculiar value. There exists with some persons a prejudice against Merino mutton, but it is entirely without reason.

CXL. DAIRIES.

Holland and portions of Flanders are largely devoted to the grazing of cattle, and to the making of butter and cheese. The Dutch butter is much celebrated; it is strongly salted and neatly packed, and may be shipped to advantage. Cheese is largely manufactured in Holland. The Dutch cheeses are well known. They are professedly made of whole milk, but I must be permitted to distrust this certainly in respect to those which I have tasted. They are made in the form of cannon-balls, weighing about seven pounds each. They are an article of extensive commerce, and are sent to market as early as they can be got ready. They are exported largely both to France and England. The taste of them is good, but in richness they are very inferior to the best English cheeses.

The Dutch dairy-rooms are models of neatness. The French denominate this quality by an expressive word, propriety; and, in the case of the Dutch farmers, it seems impossible it should be exceeded. Their vessels, pans, tubs, presses, shelves, dippers, every thing, in short, connected with the dairy is marked by a cleanness which seems perfect, and they are bright with excessive brightness. The town of Broeck has been long celebrated for its cleanness, and here not a horse ever comes; the streets or passages to the houses are paved with bricks, or with rounded stones from the sea-shore; and a well-dressed lady might almost sit down in the streets without soiling her robes. The neatness of these places is proverbial. I cannot say that I have not seen it equalled in some private examples; and the sect of the United Brethren, otherwise called the Shakers, in the United States, are quite as much distinguished in their houses and settlements for their excessive cleanness; but it is clearly impossible in this respect "to beat the Dutch;" and this most comfortable, agreeable, I will add beautiful, habit of the Dutch, is no where surpassed.

The French butter, as found in the markets of Paris, seems the perfection of this article. It is generally sold entirely fresh, and that of the first quality is delicious. It is found fresh in the markets in winter as well as in summer, and is coloured with the juice of the carrot. The French offer for sale fifty-three different kinds of cheese. Having tasted of but few, it would be presumptuous in me to characterize the whole. The cream cheese is excellent. The Neufchatel, which is merely the curd fresh and slightly pressed, is much esteemed. The Rochefort resembles the Stilton, and often equals it. These are deemed the best. I could learn nothing either in Holland or France peculiar either in making the cheese, or in the curing or use of the rennet.

The Swiss cheese, called the Gruyere, is manufactured both in France and Switzerland, is much esteemed by many persons, but its flavour is excessively strong and not agreeable. I cannot, however, decide for the tastes of other persons. The celebrated Parmesan cheese, which commands every where the highest price, is made in a limited district in Italy. The mode of making it is kept a secret. It is of a light green colour, and delicious flavour. A distinguished farmer in Switzerland informed me that they had repeatedly endeavoured to imitate it, but without success; that the agricultural societies had offered large premiums for this object; and that they had actually sent persons into the district where it is made, but they were unable to get the information. It is conjectured to depend mainly upon the nature of the feed which the cows obtain. The current opinion, that it is composed of a portion of asses milk, is considered by the best informed persons as without foundation.

I have gone so fully into the subject of dairying in my observations upon English husbandry, that I shall not extend them. In Holland, the cows are generally pastured and milked in the field. In Flanders, in parts where good pasturage does not abound, they are soiled, and in one of the best districts half an acre of clover to a cow is considered ample for the summer. In winter they have hay, straw, carrots, turnips, or potatoes, in such proportions as a judicious feeder will see to be necessary. But there prevails universally in Flanders a practice of giving the cows a mixture of ryemeal, or the meal of buck-wheat with water. This is considered as most indispensable, and, no doubt, contributes essentially to increase the milk. In general, the Flemish farmers prefer a mixture of food both for their cows and their fatting cattle, cutting up straw, hay, turnips, and carrots together.

There are modes of management in the Swiss dairies which are well worthy of notice. Where it is desired to avail themselves of the feed upon the mountains, a herd of cows is driven there in the summer; and some persons, men in the cases which I found, go with them, carrying their provision with them; and, occupying a building which is only habitable in summer, tend the cows, and make the cheese. They carry little else than bread with them, and for this they have occasionally to descend the mountain, which, with the return, is no slight task; but bread and butter-milk form their principal and almost sole diet.

In another case, in a small village consisting, it may be, of fifty or a hundred families, I found an arrangement certainly peculiar, but which seemed excellent, and capable of being adopted to advantage in many other situations. Some of the villagers kept one only, some two or three cows. A man and his wife, skilled in making cheese, were employed, in a suitable building, with all the necessary fixtures, to make the cheese for the village. The milk was carried to the place for making the cheese, morning and evening, and there measured and receipted for. Of the whey, each one, when he carried his milk, got his proportion in return. The cheese was sold on joint account; and, after deducting expenses, the proceeds were divided according to each one's contributions. This arrangement was excellent; first, for those who kept only one or two cows, and who could not, under the circumstances, make cheese but to a disadvantage; second, it saved the difficulty and trouble of a dairy-maid in the family—a class of persons who are always difficult to be procured; and, third, it assured the good quality of the cheese, by its being made by a person of known and acknowledged skill.

CXLI. FARM-HOUSES.

A Dutch farm-house is a remarkable object. They are seen scattered and alone at considerable distances from each other, over their extensive meadows, generally surrounded by a few trees. At a distance they appear like enormous barns. They are generally square, covering a large extent of ground, of one story in height, and with a roof rising to at least twice the height of the body of the house, gathering in from the four sides of the house, and terminating in a central point at the top, like an Egyptian pyramid. This roof is entirely devoted to the storage of grain and hay. The lower part of the house comprehends a dwelling for the family, sleeping rooms, and a parlour or drawing-room, which is never used but upon great occasions, such as the death or marriage of some one in the family, and a kitchen, adjoining which is the keeping-room of the family. Adjoining this kitchen, in truth making a part of it, are the cow-stalls; and adjoining this a room for the storage of the cheese, for the milk, the churns, the press, the tubs, and other dairy utensils, which, whether of wood or of brass, are kept in the most polished condition. The cow-stalls are so constructed that two cows occupy one stall together, tied by chains, with their heads to the walls, and behind them is a deep trench or drain, into which all the solid and liquid manure is received. The solid is immediately conveyed away to the heap outside the door, and the liquid is drained into a covered cistern at the side of the stable, on the outside of the house.

Into this cistern flow likewise all the slops of the house and of the dairy, and the drain is kept constantly clean by water. In summer the cows are kept and milked in the pasture; the stalls are then most thoroughly scoured and cleaned out, and either carpeted or sanded; and exhibit the same perfect neatness as the rest of the apartment in which the family live. In all cases, both in Holland and Flanders, the cow-stalls, while occupied by the cows, are frequently washed with water, which, besides the purpose of cleanliness, serves to increase the contents of the urine cistern; and over every stall is a cord suspended, by which the tail of the cow is tied when milked, to prevent her slapping the face of the milker, or throwing any dirt into the pail. Indeed, the neatness of all their arrangements is perfect. The farmer and labourers have their clean shoes or slippers at the door, where they always exchange their out-door shoes on entering, that they may bring no dirt into the house. The contrast between a Dutch farm-house and an Irish cabin or wigwam, is most remarkable.

The Swiss farm-house differs entirely from the Dutch. It is a somewhat stately erection, generally of two stories and high roof, with a piazza in front of the second story, to which there is access from the outside by steps. The lower story, or ground floor, is occupied by the live stock; and the second floor by the family. This spirit of fraternization and equality, which appears both among the Dutch and the Swiss, in regard to those useful animals upon whom their living and wealth depend, is certainly an amiable trait of character; and is much more harmless in its operation, if we may judge from the results in the two cases, than when applied to human society. The neatness of several of the Swiss farm-houses which I visited, if not so remarkable as that of the Dutch, is really exemplary.

CXLII. SWISS FARMING.

The farming in Switzerland varies very much in different cantons or districts. The soil varies, and the rugged aspect and broken and mountainous character of the country give a variety to their cultivation and modes of life, which at once impress a visiter. The habits and appearance of the population certainly differ much in different parts.

There are large portions of Switzerland wholly devoted to pasturage, and which, from their inaccessibility to the plough, can be applied to no other purpose. In these cases, where cows could not go, goats find their way. But wherever the plough or the spade can be used they are diligently employed, and this activity is stimulated in many parts of the country by a dire struggle to procure a subsistence under circumstances most inauspicious and severe. In parts of Switzerland, the melting of the snow on small patches of ground is hastened by throwing small fragments of slate-stone upon it, such, I may say, is the necessary impatience to get at the ground seasonably to put the seed in for a crop.

In some parts the country is open, and fields of considerable extent are under admirable cultivation; in other places, the smallest nook, the least patch by a running stream, and the most secluded valley, will be husbanded with the greatest care. The valley of Chamouni, enclosed by lofty mountains covered with the snows of untold centuries, and running at the very foot of Mont Blanc, the sublime monarch of these Alpine heights, was green and beautiful, waving with crops of grain; and when I was there, covered with merry haymakers. I may add, that these haymakers were almost all of them stout and active women, whom I saw mowing as well as making, raking, and loading hay. They were very cheerful, and seemed to enjoy ruddy health.

In the arable districts of Switzerland I was told that the farms consisted usually of fifty acres, and many of these farms gave the strongest indications of independence and comfort. The farms in Switzerland are divided by fences; and, with the exception of the loftiest heights, it may be said that a Swiss very much resembles a New England landscape.

CXLIII. HOFWYL. IRRIGATION.

I visited in Switzerland the celebrated establishment of the late Mr. De Fellenberg, at Hofwyl, near Berne, for education. No school is better known; and it is believed that none ever better deserved public esteem and confidence. It does not come within my province to speak of it in this place as a literary institution; but as a farm it may be considered as a model well worth studying. I have already spoken of the cows at this place, of which there were sixty, the superiors to which, in condition and produce, have not come within my view.

The most remarkable improvement which I witnessed in this place was in irrigation. The land irrigated was in the shape of a bowl or basin, of which one side was wanting. The water, after turning a flour mill, was brought a considerable distance in a race way on a bank, and then was carried round through successive rivulets formed round the sides of this semicircle or amphitheatre, watering the intervals between these gutters or trenches, and afterwards spreading itself over an extensive piece of flat land; thus, at pleasure, watering one hundred and fifty acres of land. Nothing which I have seen could be better managed; and the success of the improvement has been a valuable compensation for any expense which has been incurred. The land is kept continually in grass, and the water is let on several times in a season. It was deemed inexpedient to keep the water on more than half a day at a time.

I shall find no more suitable place than this to mention the irrigation in the neighbourhood of Milan. This is a level and most fertile country. A good deal of rice is cultivated in its neighbourhood. The fields have their trenches and cross ditches and embankments made with great care. The water is brought from a neighbouring lake, and these fields are irrigated at pleasure. Where there are facilities for it, or where even they can be formed within any reasonable expense, there are no more successful improvements than irrigation. Even simple pure water is of great fertilising power; still more when it brings with it the washings of cultivated fields, or other enriching matters, which it may collect in its course. A diversity of opinion prevails as to the length of time during which water may be allowed to remain on the land. The passage of the water over the land is preferred to having it remain stagnant; and an irrigation of a few hours' duration is generally considered more eligible than a longer continuance.

The farm at Hofwyl presents all the improvements which modern art and skill could bring to it; with the most improved implements in use. Indeed, it may be considered as a model farm. A considerable number of the pupils were lads, who pay the expenses of their education and living by their labour. There were sixty cows on the farm, of which I have already spoken. The number of pupils at this institution, which has heretofore been very great, furnished the best possible market for the abundant produce of the farm.

CXLIV. IMPORTANT PRACTICAL CONCLUSIONS.

The great points to which I think the attention of American farmers, and of other farmers, should be called I shall briefly enumerate.

1. THOROUGH DRAINING AND DEEP CULTIVATION.—The first of all improvements should be the thorough draining and deep cultivation of the soil. The Deanston system of thorough draining and subsoiling has effected immense benefits in England, and promises to establish itself as one of the greatest single improvements ever made in husbandry. In Flanders, thorough draining, as it is called, does not prevail; but their surface-draining is most carefully attended to, and trenching with the spade is even much better, though in most cases more expensive than subsoiling. Indeed, their land, to the depth of two feet in the best cultivated districts, is

completely turned over, and thoroughly intermixed once in the course of every six years.

2. Manures.—The second great point, and that which almost transcends all others in its claims upon the farmer's attention, is the manufacture and increase of manure. It must be acknowledged that the resources for this object within the reach of most farmers are not half used, and means of creating and accumulating manures are neglected or wasted, which waste, if it could be represented by any pecuniary value, would astonish us. On many an English farm there are resources for manure neglected or lost, which would be much more than an equivalent for the rent. Let me here revert to the immense value of liquid manure, and the provision for and means of saving it, which I have treated so much at large.

3. Soiling of Cattle.—The third point of great consideration is that of the soiling of cattle. There are vast tracts of pasture land, to which the plough cannot be applied. Sheep and young cattle may occupy these. But the farmer will find an immense advantage in soiling his beef cattle and cows, and oftentimes his sheep also. They will be fed at less expense; they will be more under his inspection and control; they will give him equal and, according to the opinions of many experienced farmers, greater returns in beef, butter, and cheese, than if kept in the ordinary way. Above all, the extraordinary and valuable increase of his manure-heap and cistern, under such circumstances, is a consideration above all others. Next to labour, manure is the great element of a farmer's prosperity.

4. Improvement of Live Stock.—The fourth great matter to which I would call the farmer's attention is the improvement of his live stock. It is difficult to speak too highly of

the skill and success of the English in the improvement of their breeds of sheep, swine, cattle, and, I will add, horses. I do not say that their breeds are all such as are best adapted for the United States. I need not repeat the opinions which I have already given in this matter. Different breeds of animals are suited to particular localities; and the extent of the United States presents every variety of aspect, soil, and climate; and is marked by different kinds of husbandry, such as the raising of stock for beef or labour; the growing of wool, fine or coarse, short or long; and the produce of the dairy. These points are all to be considered in the selection of a stock for breeding. An improved Durham short-horn would thrive and develope all his richness and beauty in the fertile meadows of Kentucky and Ohio, and the rich prairies of the west, who would become poor and dwarfish in some of the rocky and almost barren pastures of the north. But that to which I wish particularly to call the attention of the farmers of the United States is, the improvement of their stock by patient care, skill, and selection. They may import animals of improved breeds to advantage; they may cross the best of their own stocks with the best animals which they can find; and, above all, let them determine always to select the best animals for breeding, and breed only from the best; never sacrifice a superior calf or lamb to the butcher, nor be satisfied with the services of inferior animals for the increase of their stock, under which they are sure to deteriorate.

5. Improved Articles of Culture.—The next matter to which I beg their attention, is the cultivation of esculent vegetables, the improvement of plants, and the introduction of new articles of cultivation. The cultivation of esculent vegetables for stock, such as turnips, ruta-baga, carrots, parsnips, or beet-root, is a matter which I would strongly recommend. Besides its being more conducive to the health of the animals, to their increase in meat and in milk, it will

enable the farmer, in the feeding of his cattle, to consume his straw to advantage, and save more expensive forage; and so increase his stock.

The improvement of plants, by the careful selection of the earliest ripe, the fullest and the most perfect plants and seeds, may be carried to an equal extent with the improvement of animals. The fine barley called the Chevalier barley, and many of the finest kinds of wheat which are cultivated in Europe, are the product of some individual plants, selected in a large field, and carefully cherished by the cultivator. The difference in the time of ripening, the difference in the amount of product, the difference in the quality of the grain, are all essential considerations.

6. New Articles of Culture.—The introduction of new articles of cultivation are points of much importance. The flax crop is not by any means so extensively cultivated in the United States, as it may be to advantage, especially when the value of its seed for fatting cattle is taken into the account. No article is more nutritious nor fattening both for sheep and cattle. I am diffident in advising the cultivation in the United States of the oleaginous plants of Holland and Belgium, such as colza, rape, poppy, &c. The expediency of doing this can only be determined by experiment. The cultivation of beet-root for sugar, considering the cheapness of the manufacture where it is well understood, and managed on a large scale, and especially in connexion with the value of the refuse for feeding and fattening cattle, deserves much thought and inquiry. Without reference to the production of sugar, the value of the crop for feeding stock, considering that no crop yields more, is more relished by cattle, or keeps sound to a later period in the spring, is great, and strongly recommends it. Few crops yield more to the acre, when well cultivated, or leave the land in better condition for a succeeding crop of grain. My own views in

regard to this crop have most essentially altered in its favour.

Lucerne, sainfoin, and vetches, are comparatively little cultivated in the United States. They are all in proper situations highly valuable. Lucerne, in any system of soiling, would be extremely useful as sowing early in the spring, and giving under good culture an enormous yield, being at the same time a plant which actually enriches the soil. For later feeding in the season, the farmers of the United States have that most valuable of all plants for its forage and its grain, Indian corn, or maize. I may say, with the great Arthur Young, "that a country is signally blessed above others, which can grow Indian corn." In the middle states of the United States, sainfoin might perhaps be cultivated to advantage ; in the northern states, experience has shown that the winters are too severe for it. It makes a most nutritious and excellent hay. Vetches yield a large abundance of green feed. St. John's day rye, of which I have spoken, may be cut two or three times, and yield also a large crop of grain. This would make an excellent forage for the purpose of soiling; so, also, the improved Italian rye grass, which, when properly cared for, bears cutting several times in a season, and yields most abundantly.

I must add, in the next place, that I should be glad to see the cultivation of the vine extended in the United States. In many parts of France, Germany, and Switzerland, it occupies land, steep acclivities, heights wholly inaccessible to a horse or cart, and where the manure is always carried up, the produce brought down, and sometimes the very soil in which it grows, transported by hand. There is land enough in the United States for its cultivation without such extreme toil. As an article of commerce, it would probably prove lucrative ; and as an article of comfort, perhaps few are more grateful and harmless. I speak in this case of the light wines of France, which do not intoxicate unless drunk to beastly excess. The strong wines of Spain and Portugal are made by some factitious process, and charged with brandy; but the light wines of France, being the pure juice of the grape, exhilarate, but do not intoxicate. They take the place of tea and coffee among the labouring people, and constitute an innocent alleviation of their severe toil. I should be sorry in any way to abridge these comforts, especially as I may say in truth, after travelling a long distance in the wine-growing districts, and at the time of the wine-making, or vintage, when it is to be had in the greatest abundance, that I saw no drunkenness or intoxication in any degree; and I may add, that so far as my observation goes, there is not a more temperate people, than are to be found in the wine-growing departments of France.

I need not add, that under the auspicious circumstances in which the United States are placed, her agriculture must be constantly increasing in importance to the country itself, and to the civilized world, for her commerce penetrates every sea, and her bread-grains, as they have already done, may be of immense importance, and of indispensable necessity, in feeding the inhabitants of the old world.

This completes the task which I undertook of giving, from personal observations, an account of European Agriculture and Rural Economy. I commend my work to the indulgence and candour of my readers. It was an undertaking too great for an individual to accomplish as one would desire that it should be done. It must satisfy me, I hope it will satisfy my friends, that I have, with unceasing anxiety, sought to execute it as well as I could. It was not to be expected that I should give a complete system of agriculture; but I have constantly endeavoured to collect and present that information which would be most useful; and to convey it in a simple and practical form. I have omitted many circumstances, because they are well known. I have given full details wherever I thought they were required. As to my opinions on any subject upon which I have treated, I can only answer that they are my own; that I am quite ready to yield them, when I find, upon further information, reason so to do; and, above all, that my opinions or judgments do not encroach upon the personal right of independent judgment and opinion in any and all others.

European agriculture lays under many burdens, from which the United States are free, and I pray may long remain so. The weight of taxation in most of the countries of Europe is very oppressive. The unproductive classes are numerous to an excess. Immense standing armies; governments enormously expensive, and in a great measure irresponsible to the people; ecclesiastical establishments, and their attachés, demanding large contributions from labour, and returning, in many cases, little more in value than the bishop's blessing in Æsop's fable, are all to be sustained from the soil, and by the labour of those who cultivate it. In their present exemption from these burdens, the farmers of the United States are greatly blessed. May they duly appreciate their singular advantages, than which none greater ever fell to the lot of man in his social condition. To them we may apply the beautiful line of the immortal poet—

O! ter beati Agricolæ, si sua bona nôrint[1].

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[1] Thrice happy farmers, if they only knew their blessings.

THE END.